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SECONDARY BATTERIES.

IN a speech before the recent meeting of the Old Students Association of the City and Guilds of London Institute, Dr. S. P. Thompson volunteered some remarks to the effect that the series of articles on storage batteries, written by Mr. A. Reckenzaun for the ELECTRICAL REVIEW, were, in his opinion, of the greatest value to electricians, and that he regarded the whole as a standard work on this special subject. These articles, many of our readers will recollect, commenced in 1886, and were completed in 1888; they contained in a concise form nearly all that was then known about secondary batteries; at any rate, as far as their practical working was concerned. Mr. Reckenzaun treated the subject broadly, and he illustrated his observations by an immense array of figures and diagrams, drawn from his own every-day practice. The paper on "The Working Efficiency of Secondary Cells," by Messrs. Ayrton, Lamb, Smith and Woods, which we are reproducing in another place, naturally contains much that has been said and proved by our contributor; it is, nevertheless, of considerable interest, inasmuch as it gives results of new laboratory experiments which not only confirm existing knowledge, but at the same time offer hints for further research in particular directions. Prof. Ayrton and his assistants confined themselves to efficiency tests with a set of 20 E.P.S. cells of the "1888 type," each cell containing seven plates, which are ordinarily charged at the rate of 9 and discharged at 10 ampères; their normal capacity being 130 ampère-hours, and the total weight 59¾ lbs. These were charged with a constant current, a task which would have involved an almost intolerable amount of attention, as the experiments ranged over a long period; therefore an apparatus was constructed which regulated the resistances of the circuit automatically, and thus kept the current rate practically the same. This apparatus we illustrated on page 81 of our last issue; it is somewhat complicated, yet ingenious, and it deserves, as far as the main principle goes, the study of those who take an interest in the automatic regulation of accumulators; a subject which, in practice, is still a long way off finality. Whether a well-made apparatus on the lines indicated in the Edinburgh paper would work without any hitch outside a well-organised laboratory is a question we cannot answer; but, on the face of it, it seems as rational as any we have seen adopted in certain central stations claiming to possess self-regulating devices for charging accumulators. A fine opportunity is now open for some inventive genius to produce an instrument which should give the desired effect with certainty, but without expensive or complicated details.

Concerning efficiency tests, the authors have obtained some remarkable figures; thus it is stated that the ampère-hour efficiencies range between 111 and 98 per cent., and the energy efficiencies between 103 and 88 per cent. From this we are to learn "that if accumulators be thoroughly well charged up before being tested, then five days' continuous charging and discharging alternately, with even the maximum currents allowed by the manufacturers, fails to give the normal quantity, or energy, efficiency." If five days is not sufficient, what should, then, be the correct period, and why should the accumulator first be "thoroughly well charged" without taking proper account of this charge? Cells of the 7L E.P.S. type are supposed to have a capacity of 130 ampère-hours when discharging at the rate of 10 ampères; but the authors, according to table No. I., have only taken 119 ampère-hours out at the first discharge, and then recharged it to 114 ampère-hours. Naturally it would take a good number of discharges to get rid of the large surplus which might originally have been contained in the cells, but of which no account has been taken. Table II. reveals the fact that 154·5 ampère-hours have actually been taken out at the rate of 4·85 ampères, consequently it may have been possible that the battery contained over 50 per cent. more at the commencement of the tests than the experimenters were aware of, and it seems to us inexplicable why Prof. Ayrton allowed such irregularities to be placed on

record, especially as in the division VI. of the paper an account of a more rational method is given on the results obtained with automatic apparatus regulating the work of five accumulators. The experiments on the effect produced on the capacity and efficiency of accumulators by prolonged rests form one of the most interesting parts of this elaborate paper. Five cells, thoroughly insulated to prevent external leakage, were periodically charged, left to stand idle, discharged at long intervals, and the effects carefully noted. "Rest," say the authors, "of an accumulator, although well insulated and fully charged at the commencement, alters the accumulator so that for the first few charges and discharges, after the rest, it is a much less valuable instrument than before. A week's continuous charging and discharging day and night, however, removes this effect to a great extent; the efficiency, however, still remains lower than before the rest." Again, "from all that precedes, it follows that the previous history of an accumulator produces an enormous effect on its efficiency. If, for example, an E.P.S. accumulator be over and over again carried round the cycle of being charged up to 2·4 volts per cell, and discharged down to 1·8 volts per cell, the 'working efficiency' thus obtained may be 97 per cent. for ampère-hours, and 87 per cent. for watt-hours; whereas, if the accumulator has been left for some weeks, then, although it was left charged, the energy efficiency for the first few charges and discharges will be as low as 70 per cent."

Everyone who has had to do with secondary batteries on a practical scale, knows that energy efficiencies of 87 per cent. under normal working conditions are not attainable, and that laboratory tests with a few cells cannot be relied upon as a basis for power calculations. No experienced engineer, not even the most sanguine seller of accumulators, would be justified in allowing more than 77 per cent. efficiency under the most favourable circumstances, and we have often pointed out that the expressions "ampère-hour efficiency, or quantity efficiency," have no meaning whatever, and should be dropped out of the electrician's vocabulary.

The authors carefully avoid advancing any new views on the chemical actions in secondary batteries, and content themselves with quotations from various sources. The sediment that "fell to the bottom of the cells" was analysed; but this is of no importance whatever. If some of the active material had been forcibly removed from plates at various stages of charge and discharge, and analysed immediately, the science of secondary battery reactions would have been enriched to a great extent. This the authors promise to do with the aid of Dr. Robertson, in Dr. Armstrong's laboratory, and the results of these investigations will be looked forward to with anxious interest by a large portion of the electrical fraternity. We have frequently expressed the hope that some competent chemist might take this matter in hand, and, if possible, remove the doubts which still envelope the whole subject.

The experiments on temperature variations, and on the resistance of an accumulator when charging and discharging, are worthy of careful perusal, and, with the exception of the few deficiencies previously pointed out, the paper of Messrs. Ayrton, Lamb, Smith and Woods must be regarded as vastly superior to many to which we have listened of late at the Institution of Electrical Engineers. The concluding words of the authors, expressing the hope that they may be able to "present a graphical record of the life history of accumulators from their first formation to their death," have no doubt made the minds of the curious more curious, and the hearts of the faithful more faithful. Let us hope that both will be fully satisfied by the time these cells, born in 1888, come, after an eventful career, to their end.

"AN UPRIGHT JUDGE, A LEARNED JUDGE."

"I HAVE difficulty in understanding how it is that a considerable number of able and distinguished men should have been persuaded to give their evidence as to the alleged insufficiency of Mr. Varley's description as an anticipation. To a considerable extent, the evidence of the witnesses of the Brush Company is made up of somewhat minute and verbal criticism on the expressions used by Mr. Varley; but, in so far as these gentlemen indicate an opinion as to the insufficiency of the description in its entirety, I think their conclusions are, in part, explained by their having misapprehended the question." These significant words were spoken by Lord McLaren in delivering judgment in the compound winding case, which we publish on another page, and the scientific experts against whom they were directed probably feel that they have escaped the more scathing criticism which their evidence deserved through sheer good nature on the part of the Judge. Misapprehension of the question is a gentlemanly and courteous mode of letting them down lightly; but, in one instance at least, this lack of acquaintance with Varley's specification and previous work led some of the Brush Company's witnesses to fairly overshoot the mark, and attempt to introduce into the case a matter which, on the face of it, was utterly absurd. We refer to the effort to make believe that a separate excitation was necessary with Varley's machine; in other words, that it could not be self-exciting. If the gentlemen who so tenaciously held to this view had only allowed their thoughts to wander back to the time when Varley discovered the reaction principle of the dynamo, they must have known that his inventive genius had been wholly centred on the production of machines which excited themselves; and was it likely that, with the knowledge and experience of after years, he would deviate from the principle on which he constructed his now historical machine?

This feature we have always considered to be one of the lamest points in the whole of the Brush evidence, and its introduction, with nothing in Varley's specification or drawings to suggest such an idea, seems to savour of something beyond mere misapprehension.

However, the whole judgment is so terse, forcible, and so completely in Varley's favour, that any attempt

on our part to bring out particular points would be useless, and we can only hope that with this decision we have heard the last of compound winding in its legal aspect. The attempt to create a monopoly seems to have been a stroke of the "venture nothing, nothing win," policy of the boldest kind, and was doubtless deliberately made with the full conviction that the electrical trade would submit to demands which have twice been clearly proved to be devoid of any legitimate foundation, rather than risk the glorious uncertainty of an appeal to the law. Luckily, however, Messrs. King, Brown & Co. refused to admit claims which they believed to be baseless, and, with a determination and pertinacity worthy of the Scotch race, they have succeeded in twice carrying their case. We are not aware at what determination the Brush directors have arrived, or what complexion of the matter they will present to their shareholders; but it seems too ridiculous to suppose that they will proceed to still further extremities, although the question may be reopened and obstinately prolonged till the expiration of Brush's patent.

Whatever the future may have in store, it must be admitted that great praise is due to the Edinburgh firm for their energy and perseverance in the face of obstacles which would have simply appalled many English manufacturers; and, as they have been put to great expense for the benefit of their fellow traders, it is scarcely credible that they will be allowed to go unrewarded, and we feel that an appeal to the electrical manufacturing interests to enable them to meet their heavy costs, should meet with a cordial response. After the previous trial it was hinted that a substantial testimonial to Mr. Varley would have been a graceful acknowledgment of his inventions, the benefits of which not he, but others, are reaping; and this we trust will now be forthcoming, for but rarely do we come across a case so well deserving recognition.

Telephone Troubles from Outside Circuits.

IN an article on this subject our contemporary *Industries* draws attention to the disturbances which may arise in telephone wires from the leakage from electric light circuits. The whole subject is being fought out before Parliamentary Select Committees, and possibly something definite may be decided in the matter. The sensitiveness of the telephone is well known, but somehow or other, in spite of the considerable network of electric light conductors radiating over the housetops, we do not hear of any serious complaints made by the subscribers to the Telephone Company in London. In America, again, where electric light and electric tramway circuits are rapidly spreading, but little is said of their disturbing effects; it is true that in the case of electric tramways alternating currents are not employed, but even so-called continuous currents are not as a rule so perfectly uniform as to be unable to set up an inductive action. The one certain cure is, of course, double-twisted conductors, and although the cure would be equally efficacious if either the electric light mains or the telephone wires were thus twisted, yet it would probably be cheaper to deal in this way with the telephone circuits rather than with the electric light conductors. It might, perhaps, be suggested that the particular telephone circuits most affected should be duplicated and twisted; this would answer the purpose so long as local work only takes place, but if for exchange purposes a twisted circuit has to be connected to a single wire line, the advantage of the double wire at once disappears.

The Events of a Century.

The Chicago *Illustrated Century* devotes an article to seriously advocating the Pennock primary battery as a source of motive power for tramways. The inventor calculates that a 10 mile track with 15 cars on the overhead wire system costs $215,000, the storage battery method $200,000, cable $885,000, and the Pennock plan only a fifth of the electrical and one-twentieth of the mechanical systems mentioned. Our contemporary gravely states that Mr. Pennock, by his primary batteries, can do away with the necessity of accumulators, dynamos, overhead wires, &c., and yet run the cars at a mere fraction of their usual cost. Moreover, the speed and power attained is claimed to be far greater than with the steam engine, as will shortly be shown by a train to be run between Chicago and New York by the inventor himself. The Chicago *Illustrated Century* is just 100 years behind the times, and Mr. Pennock will have to add another century to his age before that train with primary batteries knocks out steam.

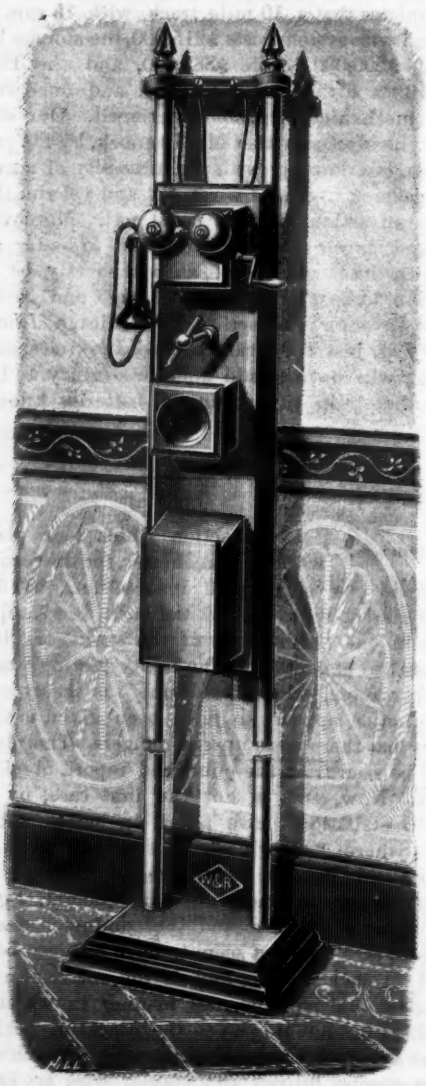
Expert Testimony.

IN an action which took place last week in Manchester, for the recovery of the agreed cost of a small installation, the defence mainly rested upon the fact that as a few lamps went wrong in one portion only of the works, the installation was bad altogether. The faulty portion was in the bleaching room, where "chlorine" is freely evolved, and no notice appears to have been given to the contractors that there were unseen dangers. The plaintiffs, as will be seen from the published report, obtained the verdict. Now, this is not the first case, by many, where installations have failed in bleach and other works where "chlorine" is evolved. The action of the acid in the damp rooms is very rapid, all fittings go at once, and, in general, the insulated wire is attacked and the conductor destroyed. Sufficient care does not seem to have hitherto been employed in such works; and if the material used has been good and suitable, the manner in which it has been fixed has left it open to the attacks of "chlorine" and the speedy failure of the circuit. For such circumstances, special fittings and special wire are required, but of what kind and quality has not yet been precisely determined. Nevertheless it is difficult to understand what method of reasoning could possibly have induced the jury to arrive at its conclusion. On the face of it the evidence seems to have been as clear against the plaintiffs as one could well conceive; therefore we can only assume that the jury was influenced by facts not made public, or that the statements of Mr. Fawcus, the manager of a rival company, were considered to be of a biassed nature. In all cases of this kind it would be well to avoid bringing forward testimony which is not of a strictly impartial character.

ADJUSTABLE TELEPHONE TRANSMITTER.

THIS instrument is intended to enable persons of varying stature to adjust the transmitter of a telephone to the particular height most suitable to them. By the turning of a handle the carriage to which the ordinary instruments are attached can be moved up and down to any required point, and, by continuation of the brass rods through the floors of a building, it is possible to make a single telephone to serve for two or more floors. The connecting wires are of course long enough to allow of considerable extension.

Any type of transmitter can be equally well employed, as it is simply attached to the travelling carriage of the instrument, which also carries the bell and battery as shown.



Some five years ago we used an adjustable transmitter in our own offices, although not designed in the form here shown, which is controlled by Woodhouse and Rawson United, Limited.

NEW DRILLING MACHINES.

IN our issue of June 27th we referred to a new machine for drilling square, hexagonal, octagonal, or polygonal holes. We now publish a description of this machine, which has been invented by Messrs. Ainley and Oakes, and perfected by Messrs. Tyler and Ellis. The original machine is similar to an ordinary drilling machine in the manner in which the spindle is driven and automatically fed downwards. The spindle, however, consists of three concentric parts. First, the outer sleeve carrying a bevel wheel, and driving the intermediate sleeve by means of a keyway and feather. Second, an intermediate spindle, having a set of five cams or cardanic circles formed upon each of its ends. There is a set of cams for each size of hole to be drilled. Third, an inner spindle carrying the tool and capable of being fed downwards either by hand or by an automatic feed, similar to the sliding spindle of an ordinary drilling machine.

The bearings or guides for the spindle consist of flat plates of hard steel made in halves and capable of being adjusted by right and left-handed screws, and suitable gearing is provided with handles and clamps. These plates are four in number, the two inner having round holes and engaging with the circular part of the spindle for drilling round holes. These are run back when the machine is drilling square holes, and the upper and lower plates, which have square holes in them, are screwed up so as to engage with the cams and give the required motion to the spindle. The pair of cams with which the square plates engage is determined by the position of the intermediate spindle, which may be raised or lowered by a hand lever and lifting gear.

This lever works in a quadrant, and is provided with five notches corresponding with the five sizes—$\frac{1}{2}$ inch to 1 inch—of holes which the machine can drill. The cams are set out as follows :—A square hole is made equal to the hole to be drilled. From any point in one side of the square, an arc of a circle is described with a radius equal to the side of the square. From the points where this arc intersects the sides of the square, other equal arcs are described completing the curve triangle. The square in which the cam is to revolve is then drawn, and from each of the vertices of the curve triangle two arcs are described which complete the figure. The point of the tool, which cuts with one edge only, must be situated beneath one of the angles of the triangle, and a different tool used for each size of hole.

In Messrs. Tyler and Ellis's improved machine, the spindle moves about the centre of a ball joint, the top end only being provided with a roller or wheel which travels round the inner edge of an annular template, being pressed outwards by a pair of spiral springs. The inner spindle carrying the tool serves a different purpose to that of the Ainley-Oakes machine. Here by lowering it, the size of the hole drilled can be varied with the greatest accuracy, while to drill a parallel hole, the whole head of the machine is lowered, moving in guides in the main framing. The templates can be easily changed, and any desired shape of hole cut. The tool is also so made that its cutting edge terminates on the centre line of the spindle, and is suitable for any sized or shaped hole. Both machines are capable, by the fitting of a cranked tool in the holder, of finishing and shaping the outsides of objects. The holes made by the machines are quickly and accurately drilled.

IMPROVEMENT IN RAILWAY SIGNALLING APPARATUS.

AN improved signalling apparatus for railways has recently been brought under our notice. Its object is to stop railway trains during foggy or snowy weather when the distant signal is at danger, and to dispense with the use of ordinary fog signals, and therefore with the men usually employed to place them upon the metals. The apparatus consists essentially of three parts. The first is a telescopic spring box platform placed on the ground in the centre of the 4-foot way; the second comprises an electric contact roller placed underneath the headstock of the engine; and the third is an electric bell and disc fixed on the footplate or engine platform. The telescopic spring box platform is attached to the sleepers, and works in conjunction with the ordi-

nary outdoor signals. It consists of two wooden boxes fitting telescopically inside one another, the outer or upper box having an overlapping lid resting upon two bent springs. Two similar springs are fixed at their upper ends to the underside of the overlapping lid. When the outer box is depressed in the manner to be subsequently explained, the lower ends of the two latter springs form an electric contact by being forced down upon a metal plate carried upon two supports. This act of making contact causes a current to flow through two wires connected with the metal plate, and to sound a gong attached to a suitable signal post erected in the 6-foot way. Upon the central part of the underside of the before-mentioned lid are fixed two brackets, to which is attached, by means of a pin, the upper end of a wire chain or cord. The lower end of this chain passes over two pulleys, and is connected to a pivotted quadrant which communicates by suitable leverage with the signal arm.

The electric contact roller consists of a roller mounted upon a hollow shaft, fixed in suitable bearings formed in the two arms of a forked metallic piece rigidly held by two springs, and having a shank which is bolted under the headstock of the engine. The roller is weighted at one end, and turns loosely upon the hollow shaft which carries a circular core of wood. This core has a portion of its upper part cut away, forming a flat surface which carries two metal bars with which a circular spring bearing against the core and arranged excentrically establishes a contact whenever the roller accomplishes an entire revolution. The two metal bars are connected at each end with two wires passing through the hollow shaft and leading respectively to the battery and to the bell arranged on the footplate of the engine.

The third apparatus comprises an electric bell, an indicator or disc connected with the bell by suitable springs, a cord to raise the indicator or disc, and a battery by means of which the bell and disc are operated when the contact roller passes over the spring box platform. It may here be mentioned that the latter platform is by means of the ordinary signal wire depressed so as to be level with the ground when the weather is clear and the signal open, and is raised during foggy or snowy weather, when the signal is moved to danger. In summer time the signal may be entirely disconnected from the platform which is then permanently held in a depressed condition, or the signal may be continuously operated in conjunction with the spring box platform for ordinary signalling purposes, whatever may be the state of the weather.

It may be well to explain the working of this apparatus. When the locomotive passes over the telescopic platform, the upper box is depressed by the contact roller, the circuit is completed, and the bell on the footplate of the engine is caused to ring, and the disc falls into the position of danger. The bell continues to ring and the disc remains at danger until the engine driver pulls the cord, thus interrupting the circuit and raising the signal to its safety position. Simultaneously with the depression of the platform, the second electric circuit is completed and the gong on the signal post sounds.

This system of signalling has been invented by Mr. J. A. H. Child, of East Greenwich, and Mr. J. Emery, of Erith. It has now been in operation on some sidings on the South Eastern Railway at Erith, for nearly a year, and has given complete satisfaction.

Dissolution of Partnership.—Mr. Wilhelm Lahmeyer, partner in the Deutschen Elektricitätswerke zu Aachen (Garbe, Lahmeyer & Co.), retired from this firm on the 1st inst. The business will be carried on as usual by Mr. H. Garbe, but Mr. Lahmeyer will still have an interest in it. The reason for his withdrawal is to enable him to devote more time to the working out of inventions relating to central station lighting and the transmission of power. He purposes, therefore, to establish a new firm, which will work in conjunction with the Aachen firm.

COMMUNICATIONS FROM AUSTRIA-HUNGARY.

[FROM A CORRESPONDENT.]

THE Metropolitan Board of Works at Buda-Pest has at last agreed to grant the local tramway company a concession for laying down a trial line for the use of the Zipernowsky vertical system (already described in full in your journal), and the grant of a permanent concession for lines on this principle will depend on the results obtained on this trial line. It is to be hoped that electrical and engineering specialists will soon have the opportunity of learning the practical value of this interesting construction.

Meantime, the Buda-Pest electric City Line, laid down by Siemens and Halske, is making constant progress in the construction of new lines. It has already at its disposal a very extensive net of lines, and has consequently been requested by the municipality to introduce transfer tickets between the different lines. This request, however, has been declined, as the proprietors have not at their disposal the number of vehicles required for this service.

The first electric tramway in a Hungarian provincial town will shortly be commenced in the celebrated Hungarian watering-place Herkules-Bad. The Royal Hungarian Minister of Commerce has granted to Victor Lorenz, Engineer, the concession for the technical preparations for an electric line leading from the railway station Herkules-Bad to the watering-place of the same name. The concession is for one year.

The erection of interurban telephone lines makes considerable progress in Austria-Hungary, especially as regards the connection of provincial towns with each other. A telephone line has been recently arranged between the little towns Kâsmark and Leibritz, which was put in action on the 16th inst.

Between Vienna and Prague, a second interurban telephone net is to be introduced, since the telephonic intercourse between these two towns has become very active. The new line is to be carried through the towns Brünn and Kolin.

The parish authorities of the Hungarian village Zichyfalva have resolved to light the streets of the place electrically. The installation is to be combined with the illumination of a steam mill situate at the distance of 1½ kilometres, so that the Dutch Colonisation Company, who are the proprietors of this mill, are to erect the installation at their mill and to supply the power from their steam engines. About 50 glow lamps will be furnished to private consumers. The entire installation is calculated for 150 glow lamps.

In the Bohemian town Teplitz, where the agreement with the gas company expires next year, a municipal electrical station is to be erected, for which several English and German and two Austria-Hungarian firms are tendering.

The Commission of Management of the Technological Trade Museum in Vienna has resolved to create a special school for electrotechnics with theoretical and practical instruction and a four-years' course of training. Its object is to train young men, having a sufficient preparatory education, as workmen of superior grades, foremen, &c., for electrotechnical works, lighting installations, &c. This special school will be the first of its kind either in Austria or Germany; it will possess a complete and excellent equipment, and it will be under the influence of a special committee of eminent practical men. If it is sanctioned by the Minister of Public Instruction, the first and second session of this school will begin in October next, the third on October 1st, 1891, and the fourth on October 1st, 1892.

A similar school, though on a more limited scale, has existed, for some years, in the Royal Hungarian Trade School at Kaschan, under the special management of Prof. T. F. Weyde. It is provided with a small electrotechnical workshop, which enables the pupils to become electrotechnicists by means of actual work.

The Vienna International Electric Company, which is to open in November the great electrical works, supplies provisionally current for illuminating the Pacher restaurant at the Vienna Exhibition of Agriculture and Forest Service, and for working a mill erected there by Ganz & Co., which is driven by an alternating current motor at the distance of 1½ kilometres from the central station.

ALTERNATIVE PATH EXPERIMENTS.

By Dr. OLIVER LODGE.

I AM somewhat surprised at the tone of controversy adopted in places by Mr. S. A. Varley in your last issue, but as he has asked repeatedly for a re-statement of my explanation of the "alternative path experiments," I give it in what I imagine to be its simplest possible form.

The experiment consists in discharging a Leyden jar through a metallic circuit, two points of which are brought very near together, and observing the conditions under which sparks occur across the air between these points.

The explanation of the spark is as follows:—When a battery, or any form of current-propeller, is used to send a current, C, through a resistance, R, the difference of potential between the ends of that resistance is R C; and if the current be strong enough, and the resistance high enough, this difference of potential may attain such value as can break down a determinate width of air gap.

In the case of a Leyden jar discharge, the current while it lasts is very strong, and the obstruction offered by a wire is very great, hence the conditions needed for a spark are likely to be satisfied.

The length of this spark (which I have elsewhere called a B spark, or a derived spark) is directly proportional to the maximum strength of the current passing, and to the impedance of the portion of the circuit intervening between the two points of derivation. The latter factor (impedance) depends directly on the frequency of oscillation of the discharge, as well as on the length and shape of the circuit; the former factor (current strength) depends on many more or less obvious things, but it depends also on the damping coefficient of the oscillations, in a way which at first sight might not be expected because of the fact that a current does not attain its maximum value till a quarter period has elapsed since the commencement of discharge (just as the swing of a released pendulum does not attain its maximum velocity till a quarter period after it has been let go); and this time though short, is long enough to permit some dissipation of energy, especially when thin iron wires are included in the circuit.

Applying this theory to my quantitative experiments they are numerically explained; and so, until some fresh experimental evidence in a disturbing direction is adduced, I see no good reason for re-opening the question. I have hitherto failed to see any such evidence included among Mr. Varley's allegations and surmises, and I really do not know why he declines to accept it, nor why he seems to feel some personal grievance in the matter of its adoption.

I am very willing to consider and answer any valid argument against the truth of such modern views concerning electrical phenomena as I have in various places endeavoured to expound, but until there is something substantial to attack, it is not much good keeping one's hand in by pummelling straw. The only point brought forward by Mr. Varley which seemed to present some plausible semblance of difficulty, viz., that about electric welding, I discussed, principally for its own sake, in the columns of your contemporary *Industries* for June 27th.

CONNECTING LIGHTNING CONDUCTORS TO GAS AND WATER PIPES.

PROF. L. WEBER has an article in the *Elektrotechnische Zeitschrift* of July 4th, in relation to this subject. He says Prof. Lodge's investigations were restricted by two presuppositions, viz., that the duration of a flash is very brief and something like a millionth part of a second, ordinarily, and that the discharge is oscillatory; consequently the only inference that could be drawn from them is, that self-induction may be best avoided by exchanging the solid conductor for a flat or a hollow one, and by making the conductors branch as much as possible; further, that the best means of diminishing the dangerous spreading of the fluid, which is due to self-induction, is to augment the conductor's capacity, and that the most practicable method of doing this is to connect the conductors to the gas and water system.

Now, says Prof. Weber, there is indubitable evidence that the duration of a flash may vary within very wide limits. There are flashes which do indeed last only for the millionth part of a second, such as those observed by Dove with his revolving disc, and these are badly described as brief duration flashes. There are, besides, flashes whose duration is ½-1 second; these are called long-duration flashes, and are further distinguishable from the others by their ruddy tint.

It is extremely probable that it is only long-duration flashes which have the power to communicate fire, although violent mechanical and physiological disturbances may be occasioned by those of brief duration. That the latter may possess oscillatory characteristics can, by analogy with the artificial sparks produced with a battery, and on the authority of Prof. Lodge's observations, be accepted; but that they possess them normally has yet to be proved.

That there may be long-duration flashes without these characteristics has been proved by photographs taken by the writer last summer, and described in the reports of the Berlin Academy. That long-duration flashes can also be oscillatory, he is not as yet in a position to deny, but the probability is against it. Naturally a multitude of variations on these two extreme types may be conceived.

It will now be seen, says Prof. Weber, that Prof. Lodge leaves untouched a class of flashes which is of long duration and not oscillatory, as well as another class whose characteristics are perfectly established. His investigations only take account of flashes whose characteristics are hypothetical, and their only practical value, therefore, is to confer fresh importance upon one of the oldest established types of conductor construction that, viz., in which the conductors are attached to the gas and water systems, and, possibly, to throw into relief the superiority of Melssen's system over that of Gay-Lussac.

The plan of construction for lightning conductors, the sufficiency of which has been made manifest by a century of use, will, Prof. Weber thinks, undergo no sensible alteration through Prof. Lodge's investigations, but rather will its usage be confirmed in every essential particular, and the difficulties which stand in the way of its wider adoption removed.

AUSTRALIAN NEWS.

(FROM A SYDNEY CORRESPONDENT.)

THOUGH Sydney itself is very much behind its neighbours Melbourne and Brisbane, in the matter of central stations, still in the matter of electric lighting of country towns, New South Wales is much ahead of either Victoria or Queensland. As your readers doubtless know, Tamworth has for some time had the electric light installed by Messrs. Harrison & Whiffan, for the Crompton Co. The installation at the town of Young has just completed its anniversary, and the town authorities

have taken it over in good working order from the contractors, Messrs. H. H. Kingsbury and Co. The town of Moss Vale also has a small plant for public lighting, as also has Enfield. The lighting of the towns of Lambton and Penrith are proceeding apace under the hands of Messrs. H. H. Kingsbury and Co., who have secured the contracts for both places. The plans are prepared for the lighting of Katoomba, a small town in the Blue Mountains, the contract for which has also been secured by Messrs. H. H. Kingsbury & Co., and the wiring of several of the houses already completed. Tenders have been asked for the lighting of Redfern, a Sydney suburb, and the towns of Newcastle and Grafton. The towns of Tenterfield, Maitland, and others, and the suburbs of Ashfield and Campbelltown are all considering the question of electric lighting in real earnest. Taking things all round, it looks as if we were going to have a boom in electric lighting in New South Wales. An electric tramway is projected in Sydney, on the Thomson-Houston system, and orders have already been sent to America for the necessary equipment. There are several well-known English electricians located in Sydney just now, viz., Mr. Elwell, of Elwell & Parker, who has just given very good evidence before the Public Works Committee on the subject of electric trams; Mr. Callender, of the Callender Bitumen Company; and Mr. J. R. Williamson, late managing director of the Edison-Swan Company of Manchester, and who has now established himself here as managing director of the Williamson Electric Engineering Company. The want of a good consulting electrician has been felt here for some time, and Mr. Robert Oxlade, late of the Eastern Extension Company, and still more recently electrician to Messrs. H. H. Kingsbury & Co. and designer of the Young installation, has thrown himself into the breach, and already his action seems to be well appreciated. At a recent meeting of the N.S.W. Engineering Association a paper on Mr. Van Rysselburghe's system of distribution by "hydro-dynamos" was read and discussed. The reader of the paper must have had a rather uncomfortable time of it, as out of about a dozen speakers not one found a word to say in its favour.

The installation at Young is on the Thomson-Houston alternating system, and comprises three 500-light 16-C.P. dynamos of 1,000 volts potential, the transformers reducing this to 52 volts for the house circuits. There are two 25-H.P. Fowler engines, one only of which is being used at present to drive two dynamos.

The streets are lighted by 10 lamps, each containing six 16-C.P. incandescent lamps, and about 60 lamps of over 16-C.P.

The rates at present charged by the municipality are as follows:—One light, per annum, £1 10s.; two lights, £2 15s.; three, £4; four, £5 5s.; five, £6 10s.; six, £7 10s.; seven, £8 10s.; eight, £9 10s.; nine, £10 15s.; fifteen, £15 5s.; all over this number 10s. per annum each.

This is about equal to gas at 3s. 2d. per 1,000 c. feet, and gas cannot be produced in Young under 12s. 6d., which shows well for electricity in New South Wales. At present only about 700 lamps are being used.

The plant being put in at Penrith consists of two 30-N.H.P. compound Robey engines, driving two 650-light Thomson-Houston alternating dynamos.

At Lambton, two 25-N.H.P Fowler engines are being used, with two 650-light Thomson-Houston alternating dynamos.

Tamworth at present has only a capacity of 500 20-C.P. lamps, the majority of which are used in street lighting, the dynamos being driven by two 12-N.H.P. semi-portable engines made by John Fowler and Co.

By the *Mariposa*, which arrived last week from San Francisco, came materials for starting an experimental line on the Thomson-Houston system. The cars are to arrive by next steamer.

Tenders for the supply and erection of plant for electric light at Bullock Island, Newcastle, gave some curious results. There were eleven tenders, ranging from £2,720 to £6,275, there being over £1,000 difference between the lowest tender and the next lowest. Crompton & Co., Ganz & Co., Siemens Bros., The Brush Company, and the Manchester Edison and Swan were amongst the tenderers, the rest being local companies.

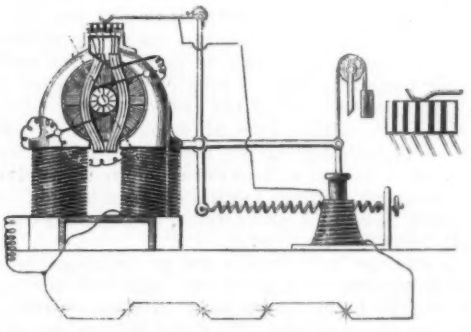
With regard to isolated electric lighting plants, the offices of the *Daily Telegraph* and of the *Evening News* are lighted, the latter having a fine set of Crompton-Howell cells; all the latest hotels have, of course, had the new illuminant installed. Circular Quay, the busiest part of the harbour, from which go the Orient, P. & O., Messageries, Maritines, &c., mail boats, and most of the ferry boats, is well lighted by means of Brush arc lamps (shortly to be replaced by Brockie-Pell), as is Cowper's Wharf, Woolloomooloo, where the American mail steamers are wharfed.

June 1st, 1890.

NEW REGULATOR FOR CONSTANT CURRENT DYNAMOS.*

THE method of regulating constant current machines, illustrated diagrammatically in the cut, consists in the application of a set of demagnetising or opposing coils around the armature, in combination with a device for varying the current in the coils or varying the number of convolutions through which the current passes.

In this machine the core of the armature contains so much iron as not to become saturated when under load. The field magnets are wound so as to operate nearly, if not quite, to saturation. The field coils are connected in multiple, and are placed, as shown, in the main circuit. In order to prevent, as far as possible, sudden changes in the magnetism of the fields, Prof. Elihu Thomson, who is the inventor of the regulator, proposes to make the field magnetism the resultant of the magnetising effect of two or more field magnet coils. These are to be placed in separate circuits having different



self-induction. The difference of self-induction in the two coils of the branches may be obtained by giving a different number of turns to the coil. The current which passes in the two coils may be made equal by having the coil resistances equal, or by adding resistance to the coil branch which has the least resistance, as is indicated to the left in the diagram. The main portion of the regulator consists in the stationary set of coils wound about the armature. These when in circuit convey current in a direction to neutralise or tend to neutralise the induced magnetism of the armature as produced by the field magnets. It is only requisite that this opposing action have a value such that under any conditions the machine yields its normal current and an electromotive force just sufficient to maintain that normal current. A moving arm at the top slides over a set of contacts connected with the sections or successive turns of the coils, as shown. This contact arm is controlled by a lever, actuated by a magnet core against the counter action of a balance weight and spring. The last-named coil is made responsive to

* *Western Electrician.*

the variation of the main current. The connections are such that when the current on the circuit increases above the normal, the arm at the top is shifted to bring into action the stationary coils about the armature. This produces an effect which opposes the effect of the magnetism of the field upon the armature, and cuts down the electromotive force. When the current falls, the regulator acts to cut out turns of the stationary coils. This gives stability of current strength under varied conditions, either with all the lights in circuit or with a lessened number.

THE BIRMINGHAM BRISTOL ROAD ELECTRIC TRAMWAY.*

THIS tramway forms one section of the Birmingham Central Tramways Company's system, and extends from the city along Suffolk Street, Bristol Street, and Bristol Road to Bournbrook, being three miles in length, and double line throughout. For about twelve years the above route was worked on the 4 feet 8½ inch gauge as a horse tramway, but having become very dilapidated and dangerous, it has recently been reconstructed to the same gauge and in a similar manner as the remainder of the company's lines, in connection with which a generating station has been erected at Bournbrock for the purpose of enabling the accumulator system of electric traction to be adopted.

The charging station, 75 feet long and 63 feet wide, where the cars are relieved of the exhausted batteries and supplied with charged ones, forms the front of the depôt, and contains four lines of rails, which run through it into the car-shed behind, which is 100 feet long and 63 feet wide. The whole of the trucks in the car-shed and charging station are provided with pits, so that an examination can be made of the motors, gearing, and brakework, wherever the car may be standing. For the removal of the cells to and from the cars there have been constructed four hydraulic elevators, with eight shelves to each elevator, capable of storing sufficient cells for sixteen cars, besides which additional storage is provided in the accumulator room, where platforms are fixed to accommodate sufficient cells for two extra cars. These can be charged at the same time as the cells on the elevator cages, which are not closed in, but are open all round, so that the cells may be thoroughly under control and examination. Underneath the whole area occupied by these elevators is a chamber which facilitates examination of the cylinders, rams, and connections, and enables the cages to fall below the floor level.

The engines and boilers are in duplicate, and each boiler is capable of generating steam for one engine, each engine being guaranteed to deliver 100 horse-power on the flywheel. The two boilers are of steel, multitubular, of the "economic" safety type, 12 feet 6 inches long and 7 feet 6 inches diameter, each with two flues 2 feet 4 inches diameter.

The dynamos, two in number, are in the same room as the engines, and are duplicate of each other. They are of the Elwell-Parker continuous current type, shunt wound, each to give 120 volts 500 ampères, at an approximate speed of 540 revolutions per minute, and do the whole of the work, charging accumulators for twelve cars, the lighting of the depôt, and the current supplying an 8-unit motor, which drives the machine tools. Dogs and slides are provided for tightening up the belts when required. The brushes are arranged to bear lightly upon the commutator, and are carried upon a rocker, which rotates to permit its being set in the best position, the brush holders being fitted with insulated "hold-off" catches. Two spare armatures will be provided to fit either of the two dynamos. Resistance coils and switches are provided for maintaining a constant electromotive force at the dynamo terminals.

* Abstract from an article in the *Engineer*.

From the positive terminals of the dynamos connection is made to the main switchboard, also in the engine room, provided with two main Cardew voltmeters, ammeters—600 ampères each—main dynamo switches and fuses, and distributing switches and fuses. On leaving the main switchboard the cable rises up to the tie-rods of the roof, along which it is conducted in a hard wood casing to the switch room, adjoining the accumulator room and the hydraulic elevators into which the cable drops, and is distributed among five regulating boards, one for each of the elevators and one for the accumulator room. Each board is fitted with ammeters, switches, fuses and adjustable resistance coils sufficient for eight circuits, *i.e.*, the eight shelves of the cage or hydraulic elevators, and carrries up to 50 ampères. The resistances are arranged so as to be capable of maintaing a constant charging current through each set of cells. A voltmeter and multiple pole switch are provided to each board for measuring the electromotive force of any set of accumulators. From one of these regulating boards connection is made with the platforms in the accumulator room, the leads from the remaining four being taken overhead along a division wall to the vertical copper strips, attached to the castings guiding the hydraulic cage elevators. These vertical strips run from top to bottom of the guides, and are electrically connected to the batteries on each shelf by spring contact blocks attached to the cage, rising or falling with it, and sliding against the copper strips. After the current has passed through the batteries on the cages, it returns by means of similar copper strips on the opposite guides to the negative lead, then through the negative terminal fuse blocks, and on to the dynamo. There are also provided portable voltmeters for testing single cells, tachometers for indicating speed of dynamos, and hydrometers for testing the specific gravity of the acid solution. The accumulators, secondary batteries, or storage batteries, are of the Elwell-Parker type, contained in vulcanite cells filled with dilute sulphuric acid, and are composed of thin lead grids, filled with a paste of red lead or minium, and placed vertically in the cell. There are 19 grids or plates in each cell, 10 negatives and 9 positives, each plate being about 8½ inches by 6½ inches. The plates are kept apart by means of vulcanite insulators, and sufficient space is left between the plates to prevent their being short-circuited in case any of the paste pellets should happen to fall out of the perforation of the grids. When placed in the car, or when being charged, eight cells are placed in a teak tray and permanently connected, three of such trays forming one of the four groups into which the whole battery—when in the car—is divided for controlling purposes. There are 96 cells to each car, giving a total electromotive force of about 192 volts, and requiring a current of about 35 ampères to charge them, an operation which lasts about 10 hours. The hydraulic cage elevators are so constructed that the cells can be removed any time, and the operation of charging is commenced by the automatic connection, made directly the trays are removed from the cars to the shelves of the elevators. The lighting of the sheds and shops is by means of 16 candle-power incandescent lamps distributed throughout the building, with wall plates for connecting with portable hand lamps. Two 200-candle-power lamps are fixed over the entrance to the charging station.

The cars—twelve in number—have been built by the Midland Carriage Company at Shrewsbury, the electrical and mechanical fittings being supplied by the Electric Construction Corporation from their works at Wolverhampton. The cars—which are very similar in appearance to the cable cars belonging to the same company—are 6 feet 3 inches wide and 26 feet 6 inches long, about 4 feet 6 inches at each end being occupied by the platforms, and are constructed to carry 24 inside and 26 outside passengers. They are carried on two bogie trucks, about 15 feet between centres, the framework being of I-iron strengthened by two King trusses. On the top of the cars reversible garden seats are provided, and inside, the usual longitudinal seats with a passage down the

centre. There are six trays on each side of the car, and each tray holds eight cells, there being 96 cells altogether. The cells are of vulcanite, and the trays of teak, each tray carried on three runners fixed to the car floor. The cells in each tray are permanently connected up in series, and the positive and negative terminals are connected to brass plates attached to opposite ends of the tray. Between each pair of trays is fixed a spring copper contact block, V-shaped, screwed to the floor of the car, with the apex of the V pointing outwards, the wings of the V spreading laterally. When the trays are pushed into the cars, the two tips of the V pieces come into contact with the brass plates on the ends of the trays, and so the whole of them are automatically connected up. The 12 trays—96 cells—are arranged in four groups of 24 cells each, the whole of the cells in each group being permanently in series, and the four positive and four negative terminal leads are brought up to the switch used by the driver of the car, by means of which the four groups may be connected up with the motor in six different ways:—No. 0, all the groups separate and disconnected; No. 1, all the groups in parallel, but not connected with motor; No. 2, the four groups in parallel, all the positives being connected together and with the positive terminal of the motor, and all the negatives together and with the negatives terminal; No. 3, half the groups in series and half in parallel; No. 4, one group is cut out and the other three groups are connected in series; No. 5, the whole four groups in series. Thus it will be seen that the whole of the cells are always in use when the car is in motion, fair uniformity of discharge being maintained. When the switch handle is at the extreme end, the whole of the batteries are on open circuit, disconnected from each other and from the motor. On being moved into the first position, the batteries are all connected up and ready for work, but not connected with motor. This position tends to equalise the batteries (No. 1). The second position connects the batteries with the motor, but only gives one-fourth of the total electromotive force, and would be used probably when travelling on the level with a light load (No. 2). The third position gives half the total electromotive force (No. 3). The fourth position gives three-fourths of the total electromotive force, one group being cut out (No. 4). The fifth position gives the total electromotive force of the whole of the 96 cells, and would be used in going up-hill with a heavy load (No. 5).

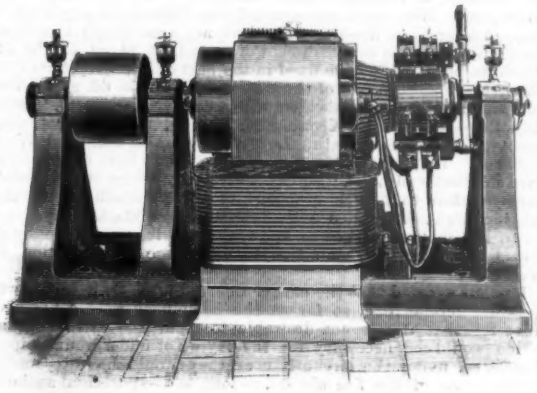
The motors are of the Elwell-Parker type, double limb, series wound, and run with 140 revolutions, but a velocity of 700 revolutions per minute is required to maintain a speed of eight miles per hour. There is only one motor to each car, carried on one of the bogie trucks by means of an aluminium, brass, or steel frame, which has three points of support, two being rigidly fixed on one axle of the bogie, and the other resting on the second axle, through the intervention of a strong helical spring. Thus it will be seen that the motor and its appendages are entirely independent of the oscillation of the car, due to variations of load. At one end of the armature are the commutator and brushes, and the other end carries a pinion, which gears right and left into two spur wheels carried by countershafts on a brass frame. On these same countershafts are fixed additional pinions, which gear into spur wheels on the two axles of the bogie, and thus the motion of the armature is gradually reduced to the speed required for the car, the proportion being about 6¼ to 1. All the gearing is done by helical teeth.

The switch, by means of which the driver controls the current, and therefore the car, is placed on the car platform just beneath the steps, and is quite out of the way of the passengers. The lead, &c., joining the cells up to the switch, are enclosed in a teak matchboard casing, the switch being placed on the top of the casing. The part of the car floor over the motor is removable. The cars are lighted by two 16-candle-power incandescent lamps—one at each end. A powerful brake is provided, which grips the whole of the eight wheels at the same time, and there is also an auxiliary brake attached.

THE PREECE DYNAMO.

IN the Preece dynamo, to which we referred in a recent issue and of which we now give an illustration, the bed-plate and brackets are one complete casting. The plummer blocks are fitted with adjustable phosphor bronze bearings, and each bearing is fitted with a sight feed lubricator.

The magnet yoke, which is cast in one piece, is let into a recess in the bed-plate, and the pole pieces are separate castings bolted to the magnet yoke. The field coils are wound upon separate shells with zinc flanges, and are interchangeable for all machines of the same output. The armature is built up with charcoal iron discs insulated from each other with a specially prepared varnished paper, and are held in position on the shaft by two insulated bolts passing through the driving



end plates which are firmly keyed to the shaft. The armature core is ventilated internally by suitable divisions being left at every 2 inches between the plates. The armature is wound one layer deep, with 19/17 strand braided cable, and connected up to a 60-part commutator, there being one complete turn per commutator bar.

The armature on the pulley side is provided with a blower to send a current of air through the pole pieces and prevent an accumulation of dust; both ends of the armature are protected with brass shields fitted to the pole heads. The brushes are made of soft brass wire and their pressure upon the commutator is regulated by thumb screws.

At a speed of 800 revolutions per minute the E.M.F. is 110 volts, and the current at full load, 250 ampères, there being no sparking. The rise of temperature after 10 hours continuous run is said to be 40 degrees on the armature conductors, and the field coils 30 degrees Fah. above the temperature of the air.

A Locomotive Telephone Signal.—In order to show that the telephone may be adopted as a danger signal on railway lines, a locomotive telephone signal was recently tested by the Baltimore and Ohio Railroad Company on about three miles of its track. The apparatus consists of a single iron rod running between the rails, supported on insulators, and an electric gong connected with a battery carried on the locomotive. The connection between the gong and the iron rod is made by means of an insulated wire from the gong to a wire brush underneath the locomotive, which touches the rod. Two trains approaching each other on the same track will complete a circuit and warn each other by ringing the gong. The gongs on the two trial trains commenced ringing when they were about two miles apart; the telephone mouthpiece was then switched to the wire, and conversation was carried on between the two drivers. The apparatus is stated to have worked very satisfactorily.

C

LONDON COUNTY COUNCIL AND OVERHEAD WIRES.

OBJECTIONS OF LOCAL AUTHORITIES.

ON Tuesday last, at the weekly meeting of the London County Council at Spring Gardens—Mr. Alderman HAGGIS in the chair—Mr. NATHAN MOSS, the Chairman of the Fire Brigade Committee, submitted a report containing the following statement:—

"We have to report with respect to the 200 additional fire-alarms authorised by the Council on 30th July last, that we have ascertained from the Post Office that the average annual cost of the call-points on the north side of the Thames will be about £9 12s. 8d. As this sum is less than the amount (£10) which we estimated, we have given directions for the work to be put in hand. As regards the additional fire-alarms south of the Thames, however, we have been informed by the Post Office that, in consequence of the objections of the local authorities of certain districts to the erection of overhead wires, underground pipes would have to be specially laid for the wires in such districts. The annual cost of the fire-alarms would, in consequence, be increased in some cases as much as four and five-fold. In fact, in one instance, at Tooting, a single call-point would cost more than £53 a year. We cannot recommend the Council to pay such a large sum for these fire-alarms, and we are accordingly unable at present to order the establishment of more than 20 out of the 52 which we proposed to have fixed in the part of London referred to. The average annual cost of these 20 will be £10 5s. 6d. each. The following are the stations which will not have their complement (10) of fire-alarms, viz.: Kennington, Tooting, Clapham, Battersea, Shooter's Hill, Blackheath, Lewisham, Camberwell and West Norwood. We may mention that we propose to have a fire-alarm fixed in Blackwall Lane, East Greenwich, the Vestry of Greenwich having asked that such a means of communication with the brigade might be afforded to the inhabitants of the locality."

Mr. BEACHCROFT wished to know whether it was the policy of the Fire Brigade Committee to encourage the erection of overhead wires?

Mr. Moss stated that the matter referred to in their report was a rather serious one, so far as the committee were concerned. They felt that it was not desirable to incur the extra expense which would be necessary for the laying of underground pipes. Therefore, under the circumstances, they would have to forego placing some of the fire alarms, so long as the parochial authorities were so strongly opposed to overhead wires.

Mr. BEACHCROFT hoped the Council would not encourage the abominable example set in some cases of erecting overhead wires. (Hear, hear.) He hoped the committee would bring forward a special report on the subject.

ANOTHER ELECTRIC LIGHTING BILL.

Mr. CHARLES HARRISON, as Chairman of the Parliamentary Committee, reported as under:—"We understand that another Electric Lighting Confirmation Bill is to be introduced, and that it will contain orders affecting the City of London. We were authorised on the 3rd June last to present a petition against any order which does not comply with the Council's resolutions of the 28th January and 22nd April, 1890, and we have authorised the preparation and presentation of petitions in the event of any of the orders complying with the above-mentioned resolutions."

NOTES.

Cardiff Lighting.—At a recent meeting of the Lighting Committee, a deputation from the residents of Broadway attended, to ask for better lighting of that thoroughfare. It was stated that a great many shops now empty, would be occupied if Broadway were better lighted. The deputation were told that the matter would be favourably considered. The committee next received a deputation consisting of Mr. Garcke (secretary and manager), and Mr. Deakin (local manager), of the Brush Electric Lighting Company. Mr. Garcke dealt at length on the advantages of electric lighting, and urged the committee to recommend to the corporation that they support the application of the company next session of Parliament for a provisional order to illuminate Cardiff with the electric light. The chairman said that so far as a promise or entering into any contract, the committee were not in a position to take action. The deputation then withdrew. A motion that a special meeting be called to consider the matter, and that in the meantime the Town Clerk be instructed to ascertain if any corporate bodies had obtained provisional orders, and had granted them to electric lighting companies, and if so, upon what terms; also that the engineer procure particulars as to subways in use in other towns, the laying of subways in Cardiff, and other details.

Electric Lighting in Newcastle.—It has been resolved by the Lighting Committee of the Newcastle Corporation, to recommend the Watch Committee to light the whole of Neville Street with five electric arc lamps, in place of 80 or 90 gas lamps.

Electric Lighting in South East London.—The Committee of the House of Commons has passed a Bill confirming a provisional order granted by the Board of Trade to the Electric Installation and Maintenance Company for the electric lighting of the district surrounding the Crystal Palace. The area is defined to consist of a portion of the district of the Lewisham Board of Works, and small portions of Beckenham, Camberwell, Lambeth, and Croydon. The order granted to the Metropolitan Electric Supply Company for lighting the parish of Paddington was also confirmed.

Electric Lighting at Mirfield.—Messrs. Lister, of Battyeford, Mirfield, contemplate having the whole of their works lit up by electricity. This is the sixth firm in Mirfield which has introduced electric lighting.

Electric Lighting of St. Pancras.—The electricity committee reported at the last vestry meeting that some 43 tenders had been received. The committee promises to report thereon at the earliest possible date. The London Electric Supply Corporation and the Metropolitan Electric Supply Company are again making applications for provisional orders to supply St. Pancras.

Barnsley and the Electric Light.—Considerable discussion is taking place in the Barnsley Town Council with respect to Mr. Bromley Holmes's advice that the Westinghouse Electric Company's tender be accepted at a cost of £17,800. The Barnsley *Independent* takes up the subject warmly, and wants to know why the tender of an English company, the National Electric Supply Company, for £11,888, should not be accepted. It concludes its article as follows:—"We also think they ought to give the work to English firms, in preference to giving it to firms which are not English. The question is a wide and an intricate one; but, on the face of it, this passing over of an English tender for an American tender which is *dearer*, will require considerable explanation, we think, before it can be rendered acceptable to the ratepayers. Seeing that the idea of introducing the electric light into the borough took its rise from the desire to get an illuminant cheaper than that supplied by the Barnsley Gas Company, the policy proposed by the Town Council may surely with reason be spoken of as economy extraordinary."

Lighting the Portman Rooms.—Messrs. Benham and Sons inform us that they have secured the contract for electrically lighting the Portman Rooms (formerly Madame Tussaud's exhibition. The Metropolitan Electric Supply Company is arranging a special main from the Manchester Square station.

Electric Light in Edinburgh.—At a sub-committee of the Lord Provost's Committee of the Town Council had under discussion last Friday the question of an electric supply for the city. Some conversation took place, and it was resolved that the Parliamentary solicitor should be instructed to report upon the position of the corporation in the matter.

Robbery of Platinum.—At the London Sessions, July 17th, four men, named Jeffries, Hewlett, Fenn, and Price, were brought up for judgment, having been convicted at the last sessions of stealing a large quantity of platinum, valued at between £800 and £900, the property of the Brush Electric Light Company, of Belvedere Road, Lambeth. Jefferies was sentenced to five years' penal servitude, following on previous convictions; Hewlett to sixteen, Fenn to ten, and Price to seven months respectively. The police engaged in the case were specially commended for their conduct.

Electric Traction at Birmingham.—The official inspection of the electric tramway on the Bristol Road by the Board of Trade has been made by Major-General Hutchinson, who was accompanied by Major Cardew, inspecting officer of the Electrical Department of the Board of Trade. The inspecting officer proceeded to Navigation Street, where he boarded one of the electric cars. The journey to Bournbrook, a little over three miles in length, was satisfactorily accomplished. The car ran rapidly to the Bristol Road, and Major-General Hutchinson, who was riding with the driver, suddenly gave the order on one of the inclines to stop the car. This was done to test the brake, and from the moment the brake was applied the car barely moved a length. Major-General Hutchinson was hardly satisfied with this. In his opinion the brake should have acted with greater effect, and the car should have stopped much more quickly. On reaching the depôt at Bournbrook the Major-General inspected the engines, the electrical machinery, the elevators, and the cars. Shortly after 2 o'clock the return journey was commenced. On the decline from Wellington Road to Belgrave Road the car was suddenly stopped, but the distance run after the application of the brake was again greater than the inspecting officer approved. When the car rounded the curve from Suffolk Street to Navigation Street the speed was increased, and the vehicle proceeded down the street at a tremendous pace. Suddenly the brake was applied and the car was once more stopped within a length. The inspecting officer was still dissatisfied. He considered the car should have been pulled up much quicker, and he had the brake tested two or three times. The inspecting officer suggested two or three alterations for the purpose of improving the efficiency of the brakes, and these Mr. Joseph Smith promised should be carried out. The inspection, which in every other respect had been very satisfactory, then terminated.

The Western Union Cables.—Mr. G. von Chauvin writes:—There appears to be an impression that the fire at the Western Union building in New York has interfered with the despatch of cable messages over my company's Atlantic cables. As both the Atlantic cables of my company run direct into a special office—16, Broad Street, a considerable distance from the Western Union building—no delay has arisen to our Atlantic cable traffic.

The Dire Effects of Magnetism.—The writer of "Table Talk" in the Birmingham *Daily Mail* had some funny things to say on Saturday last respecting the Bristol Road Electric Tramway. After assuring his readers that the electric tram depôt at Bournbrook is a much more interesting place to visit than one might suppose, he gives this piece of advice to anyone who is about to go there—leave your watch at home. During the several inspections that have taken place recently, several gentlemen have afterwards found that their watches persistently refused to go. Curiously enough, however, whilst some had this experience others have discovered no unfavourable effect upon their "tickers." Hereupon it seems that the newspaper man sought the reason, and he relates how one of the electricians told him that this was attributable to the fact that different individuals are very differently affected by electric influence. One person, said his informant, will much more readily transmit electricity than another. He goes on:—"There is an impression which I have frequently heard expressed that passengers by the electric cars will be liable to the same sort of thing; but I am assured that this cannot be so, as the force is not generated, but merely stored in the lower part of the cars, and is completely insulated."

Channel Telephone Cable.—It was stated last week that experiments are being made with a view to laying a telephonic cable across the Channel. We are under the impression that tests over the existing cables have been going on for some considerable period.

Got the Needle.—A lady stated last week, in the columns of the *Times*, how she had been duped by a gentleman calling himself an electrician, who undertakes the removal of superfluous hairs by the agency of the electric needle. She paid a guinea and signed a cheque for £45 before operations commenced, and had not been home a week before all the hairs commenced growing again. These, she was coolly informed, were new ones, and she was impudently asked how much more money she was willing to pay. She suggests that probably an action at law would have ended in her favour, but that would have involved further expenditure, and this she did not care to incur. There are other so-called electrical curative appliances besides needles which we should like to see dealt with in the same manner in the columns of the daily Press, and perhaps we may take the above publication as a good omen.

A Telegraph Office Destroyed.—An explosion took place at the Western Union Telegraph Company's offices, Broadway, New York, at seven o'clock on the morning of the 18th inst., in the battery room on the sixth floor, and the flames, which immediately broke out, soon spread to the portion of the building above, including the operating room and the offices of the Associated Press, both of which were gutted, while the lower floors were drenched with water. The loss is estimated at 250,000 dollars. Only about forty operators were on duty at the time, and all succeeded in effecting their escape.

Railway Contracts. — Woodhouse and Rawson United, Limited, have again secured the contract for the supply of electrical instruments on the London and North-Western Railway for the ensuing year. This contract has now been held by the firm for several years, whilst it has also been awarded the contract for the supply of instruments to the Caledonian Railway for the year.

The American Eagle.—The *Electrical Engineer* of New York has every reason to believe that Mr. Ferranti will emerge triumphantly from his arduous labours over the Deptford scheme; indeed, our contemporary thinks that there is now sufficient evidence to show that complete success will ultimately be attained. We sincerely rejoice to note that "the courage and enthusiasm which have thus far accompanied his work may possibly be traced to the touch of Yankee blood in his veins."

Morgan's Electric Signal System.—We are informed that the patent rights of this invention for the whole of Europe have been sold for £250,000. Operations in connection with the practical demonstration of the system in the Brixton district are now being carried on, and instead of 12 lamp-posts, as previously reported, it is proposed to erect 36.

Promotion of New Companies.—As many of the electrical companies which have recently been brought before the investing public have not been floated, the bringing out of several of the proposed new companies for dealing with electric traction, welding, lighting, &c., has, according to various authorities, been postponed for the present.

Killed by Lightning.—The artillery barracks at Comorn, Austro-Hungary, were recently struck by lightning. The electric fluid penetrated three rooms, and threw twelve men out of their beds. Two of the men were killed on the spot.

Pneumatic Telegrams in Paris.—A treaty securing for the Paris suburbs pneumatic telegrams in order to correspond with Paris has just been signed between the Director-General of Posts and Telegraphs, and M. Aigoin, director of the southern tramways, the author of the pro'ect

Submarine Navigation.—A Madrid telegram of last Saturday says: "In view of the recent successful trials with Lieutenant Peral's electric submarine vessel, the Minister of Marine has appointed a Commission to report upon the advisability of the Government ordering the construction of several submarine torpedo boats."

Electrical Enterprise in Saxony.—A concession has been granted to a civil engineer and a firm of bankers in this city, authorising them to establish a network of cables for purposes of transmission of power and electric lighting direct from some coal mines through 168 towns in Saxony to Dresden.

Hotel Métropole, Brighton.—The electric light fittings for this hotel, which possess certain features of novelty, have been supplied by Messrs. Benham and Froude. The principal bed rooms are fitted with very pretty portable table pillars of four distinct types, the incandescent lamps burning within opal shades covered with silk and lace, of tints to harmonise with the decorations. In the private sitting rooms and important vestibules are electroliers in brass, richly chased and burnished, having from three to ten lights each, with tinted and cut shades and rope-like down rods. For the principal suite of three large public dining rooms, what may be termed "electric sunlights" have been adopted, several being fixed within a very few feet of the ceiling of each room. They comprise a large, handsome deep inverted brass disc, embossed and highly polished, within which are a number (varying from five to ten in one or two tiers) of glow lamps, the whole being surrounded by a heavy fringe of cut glass prisms, the glittering brass and the prismatic hues giving a most brilliant, sun-like effect. This arrangement was carried out in accordance with the ideas of the proprietors of the hotel.

The St. Pancras Vestry.—A curious specimen of the manners and customs of vestrymen came to light at a recent meeting of the St. Pancras Vestry, when it was proposed to fill a seat on the Electric Lighting Committee in the place of a retiring member. One of the two candidates was asked if it was true that he had issued cards to the committee, recommending a gentleman who wished to introduce a new scheme, and he explained that he had known the gentleman referred to for many years, and he was one of the most eminent electrical engineers in the metropolis. He had received an invitation from him to visit an installation at Paddington that had been in existence some four years, and to bring some friends with him, and he thought that it would be very interesting to the members of the committee to see an installation in good working order, and he accordingly invited some of them. Being further asked if it was true that at the last vestry meeting he introduced several members to this most eminent electrical engineer, he replied that the M.E.E.E. had certainly sent in his card and wished especially to be introduced to Mr. Westacott. If this was blandishment, it was utterly thrown away. Mr. Westacott hotly denounced the candidate's proceedings as a scandal, especially after the committee had already accepted the services of another eminent engineer. It was a curious fact, he said, that the M.E.E.E. knew all that had taken place in committee. The rival candidate, who, it was said, had been for ten years connected with electric lighting, was elected to the vacant seat.

Coatbridge Lighting.—Says the *Glasgow Herald*:—The decision given in the case of the Coatbridge Electric Lighting Provisional Order is of very considerable importance. It is the first case in which an electric lighting provisional order has been opposed by a gas company on the ground of competition, and as the gas company got the worst of it, it may be assumed that Parliament has set a precedent against such opposition for the future.

Lavoisier's View.—M. Berthelot, a member of the Academie Français, has written a book called "La Révolution de la Chimie Lavoisier," in which Lavoisier's incorrect but historically interesting opinion as to the nature of electricity is given as follows:—"I have thought for some time that the electric phenomena, like the phenomena of combustion, are merely the effect of decomposing air, and that electricity, consequently, is nothing but a very slow combustion."

The Electric Sugar Fraud.—The New York Courts have given judgment in favour of the English stockholders.

Electricity and Water Power.—The Sheffield Water Committee, in view of the probability of the Corporation obtaining power to supply electricity for public and private purposes in the borough, has called attention to the water power connected with their wheels on the Rivelin.

Telegraphists and the State.—The *Electrical Engineer* of New York points to England as proving that the lot of a "telegrapher," where the telegraphs are under Government control, is not one to be envied. Our contemporary has discovered a "rumour" that the Post Office contemplates sending to America for men, and observes that the few who might possibly go would hardly be likely to find America a pleasant country to return to.

The Columbian Exhibition.—An influentially-signed petition, the signatures of which include all the leading men and houses in Chicago, has been sent to the board of directors of the World's Columbian Exposition, requesting the appointment of Mr. J. P. Barrett, the City electrician of Chicago, as director of the electrical department of the exhibition. Mr. Barrett is a public official without commercial alliances, and his name has frequently figured in our pages.

Telegraphs in South Africa.—A correspondent writes to a contemporary that the Chartered South African Company's line of telegraphs has now been completed as far as Ramoutsa. The first message transmitted over the new line was one from the Chief Ikening to Sir Sydney Shippard, Administrator of British Bechuanaland. It was as follows:—"Congratulations on telegraph office being opened here. Hope it will lead to prosperity of my people. Am doing the best I can to get Mr. Stanford all the men he requires, and will help him in pushing forward with his work. It is a wonderful thing telegraphy. I am in the dark. I cannot understand it." The company is now laying the wire from Ramoutsa to Meschudi Lindewe's Town, which is to be the next station.

Personal.—Mr. Mark Bevan has commenced business at Cardiff as an electrical engineer and contractor. Mr. Bevan was, for several years, superintendent at Rio-de-Janeiro, for the Western and Brazilian Telegraph Company, and for 4½ years was in the service of Messrs. Siemens Brothers and Company at their works at Woolwich. On the recommendation of Messrs. Siemens Brothers he afterwards held the appointment of chief electrical engineer in the Torpedo Division of the Argentine Navy, and a similar appointment under the Chilian Government.

Intended Electric Light on Borkum Island.—The German Government has given notice that, during the summer of 1890, an electric light will be placed on Borkum Island, east side of River Ems entrance, about 1,200 yards southward of the principal lighthouse. It will be elevated 105 feet above high water, and should be visible in clear weather from a distance of 16 miles. During the summer of 1890, an electric light will be also placed near Campen, about four miles northward of Knock Lighthouse, east side of River Ems.

The Houses of Parliament Lightning Rods.—Messrs. R. Anderson & Co., the firm responsible for the lightning conductors on the Houses of Parliament, write respecting the recent fall of a piece of masonry, when Mr. Justice Grantham narrowly escaped. They state that examination has proved that the piece of stone had been cracked for some time before, and that the building was in no way damaged by lightning.

Austin's Infant Dynamos.—Mr. Austin informs us that he has secured Messrs. Paterson and Cooper as London agents for the sale of his dynamos and motors.

NEW COMPANIES REGISTERED.

Electricity Supply Companies Union, Limited.—Capital, £100 in £1 shares. Objects: To form centres at which electrical energy may be generated and accumulated, and from which the same may be distributed for public and private lighting, for motive power or heat, for electro-plating, electro-deposition, telephonic, or other purposes. Signatories (with 1 share each): J. D. Pearson, 3, Oakleigh Road, New Southgate; W. A. Pittman, 7, St. Helen's Gardens, North Kensington; J. Aspinall, 34, Bowman's Buildings, Edgeware Road; Wm. May and A. W. Bartlett, 18, Austin Friars; J. B. Rands, 5, Linnell Road, Camberwell; G. W. Schofield, 27, Austin Friars. Registered without special articles by Slaughter and May, 18, Austin Friars.

Amalgamated Electricity Supply Companies, Limited.—Capital, £100 in £5 shares. Objects and signatories as in preceding company. Registered 16th inst. by Slaughter and May, 18, Austin Friars.

United Electricity Supply Companies, Limited.—Capital, £100 in £5 shares. The objects and signatories are the same as in the two preceding companies. Registered 16th inst. by Slaughter and May, 18, Austin Friars.

Woodward, Grosvenor and Company, Limited.—Capital, £90,000 in £10 shares. Objects: To take over the businesses of Woodward, Grosvenor & Co., and the Stour Vale Mill Company, carried on at Kidderminster and 102, Newgate Street, and to trade as carpet manufacturers, spinners, general merchants, engineers, electricians, soap and glue manufacturers, &c. Signatories (with 1 share each): *G. W. Grosvenor, Broome House, near Stourbridge; *H. Mountford, Thurlow Park Road, West Dulwich; J. Mountford, M. Waite and R. Moule, Kidderminster; J. Lignton, Streatham Park; H. C. W. Mountford, West Dulwich. The first two signatories are appointed managing directors, each at a salary of £1,000 per annum. The company in general meeting will determine remuneration of ordinary directors. Registered 18th inst. by Emmett, Sons and Stubbs, 14, Bloomsbury Square.

Franco-African Lighting Syndicate, Limited.—Capital, £25,000 in £1 shares. Objects: To carry on in Algeria, Tunis, or other part of the French Dominions or Protectorates, the business of a gas or electric light company in all branches. Signatories (with 1 share each): E. G. Inman, 269, City Road; W. Cousens, 17, Victoria Street, S.W.; G. A. Stanbrough, 8, Hethering-ton Road, Clapham: T. W. Gardiner, 6, Heiron Street, S.E.; F. Burbidge, 44, Amwell Street, E.C.; E. Boucher, 229, High Street, Lewisham; E. G. Tanton, 11, Queen Victoria Street. Directors remuneration, £50 per annum each, and in addition 10 per cent. per annum on the net profits, the chairman to be entitled to double fees. Registered 19th inst. by Wm. Cousens, 17, Victoria Street, S.W.

Earthy Metals Company, Limited.—Capital £2,000 in £50 shares. Objects: To carry out an unregistered agreement with Luis Falero, M.F.S.T.E. To produce and prepare for market, sodium, potassium, magnesium, aluminium and other metals, and to carry on business as metallurgists, manufacturing chemists, and of makers of and dealers in electrical, chemical and scientific apparatus and materials. Signatories (with 1 share each): Major J. G. Scott, Winkfield, Berks; A. Codogan, 3, Sloane Gardens, S.W.; J. M. Maclean, M.P., 40, Nevera Square; J. W. Macfarlane, 2, Lexham Gardens; R. St. John Boddington, 15½, Parliament Street; H. M. Cadell, Bourness, N.B. Registered 19th inst., without special articles, by E. R. Crump, Solicitor, 15½, Parliament Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Windsor and Eton Electric Light Company, Limited.—The registered office of this company is situate at 54, High Street, Windsor.

Corinthian Electric Medical Battery Company, Limited.—The annual return of this company, made up to the 30th June, was filed on the 15th inst. The nominal capital is £25,000 in £1 shares. 20,804 shares have been taken up, 20,000 of these being considered fully paid. Upon 804 shares the full amount has been called, the calls paid amounting to £800, and unpaid to £4. Registered office, 1, Gate Street, Lincoln's-Inn-Fields.

Siemens Brothers & Co., Limited.—The annual return of this company, made up to the 15th inst., was filed on the same day. The nominal capital is £500,000 in £100 shares, the whole of which are taken up. The sum of £85 has been called and paid upon each share, the paid up capital thus being £425,000.

Mining and General Electric Lamp Company, Limited.—The annual return of this company, made up to the 17th inst., was filed on the 19th instant. The nominal capital is £100,000 in £1 shares, 90,000 of which are taken up, 62,305 being considered fully paid. The full amount has been called and paid upon 27,695 shares.

CITY NOTES, REPORTS, MEETINGS, &c.

The United River Plate Telephone Co., Limited.

IN the absence of Lord Thurlow, Mr. J. Irving Courtenay, the deputy chairman, presided at the fourth annual ordinary general meeting of the shareholders, held at Winchester House on Tuesday last, to receive the report (printed in our last issue) and accounts for the year ending March 31st, 1890. About half a dozen shareholders were present.

The Chairman said the financial position in Buenos Ayres could not but be a cause of anxiety to all who were interested in the Argentine Republic. But from the best obtainable information—and the company was fortunate in numbering amongst its directors gentlemen who had passed the greater part of their lives in the River Plate—he believed that, with a prudent administration of its affairs, the country, with the aid of its great resources, would speedily overcome its present difficulties. The company's gross income for the year ending March 31st, 1890, amounted to £108,612 2s. 7d., as against £81,866 2s. 4d. for the previous twelve months. Those figures showed how largely the business had developed during the past year. There had been a considerable increase in working expenses, which was mainly caused by a large increase in wages and cost of material. Fortunately, there had been no serious question with the *employés*, but, as in the case of other River Plate companies, the depreciated currency had made the increase inevitable. There had also been some increase in taxation. These had caused an increase in the working expenses. A special item of expenditure was owing to the repairs rendered necessary by a cyclone in Rosario last December. The gravest loss, however, and that which was the cause of their reduced dividend, was that on exchange. It was one beyond the directors' control. It amounted to not less than £22,334 17s. 1d., as against £14,689 6s. 8d. in the previous year, or an increased loss of £7,645 10s. 5d. The total loss from this source was, therefore, about 8 per cent. on the company's paid-up capital. The result, after paying working expenses, debenture interest, and general charges, both in the River Plate and in London, was a profit of £34,198 6s. 5d., from which, after deducting the loss on exchange, viz., £22,334 17s. 1d., there remained a net profit of £11,863 9s. 4d., which, added to the balance from last year, viz., £1,210 7s. 2d., amounted to £1,373 16s. 6d. An interim dividend of 2 per cent., or £5,800, was paid in January last, and the directors recommended a further payment of 1 per cent. out of the balance. They proposed to carry forward £2,000 to the depreciation and renewal account, which would then stand at £9,000,

and they carried forward a balance of £2,373 16s. 6d. In view of the abnormal state of business in the Republic (which had continued for some time) the results obtained were fairly satisfactory, and he trusted the policy of the directors in carrying forward a substantial sum would be approved. There were some encouraging features in connection with their business in the Plate. On the 31st March, 1890, the date of the balance sheet, the number of their subscribers at Buenos Ayres was over 5,000. The company began business with about 3,000 subscribers. As might have been expected during such a crisis, a considerable number of people had taken out their telephones; but, on the other hand, each month had seen a steady influx of new subscribers, and, all things considered, the business of the company showed a most remarkable vitality. That was mainly owing to careful and vigilant administration both in Buenos Ayres and in Rosario. One of the company's representatives in Buenos Ayres wrote:—"We are giving a service such as we can safely say has never been given in Buenos Ayres before. Of course we have complaints, but they are brought down, we think, to a minimum and neutralised by the many expressions of satisfaction we hear on all sides." The shareholders would congratulate themselves upon having such painstaking and zealous representatives as Mr. Fells and Mr. Crabbe at Buenos Ayres and Mr. Chapple at Rosario. The directors had successfully carried out what was hinted in last year's report—*i. e.*, they had raised the rates of subscription with a view to meet to some extent the increased expenditure and exceptional charges incident to the condition of currency in the Plate. The capital outlay for 1889—90 was £7,297 14s. 11d. less than in 1880—89, and that allowing for the outlay during that period for the purchase of the Rosario business. They had not lost sight of the construction of the Rosario trunk line, to be undertaken when a favourable opportunity presented itself. The issue of the 5 per cent. debenture stock and the conversion of 7 per cent. debentures had been satisfactorily carried out, and had evidently been appreciated by the shareholders. He was confident of the company's future. It was plain the business was steadily improving, and they might therefore expect at the end of the crisis to reap the fruits of the solid progress and the improved position they had attained in spite of the serious increase of financial obstacles they had and still encountered. Their receipts for the first quarter of the new year — that is, April to June — had exceeded those of any other quarter since the company started business. He moved the adoption of the report and accounts, and to declare a dividend of 1 per cent., or 1s. per share free of income tax (in addition to the interim dividend of 2 per cent. paid in January last), payable out of the remaining balance of £7,273 16s. 6d.—viz., £2,900.

Mr. Frank Jones seconded.

Mr. Peel, a shareholder, congratulated the directors upon the present position of the company. He, however, thought they might have imitated other companies and maintained its dividend. But that was a question of finance, and the directors might have acted discreetly under the circumstances.

Dr. Ellis asked whether the large increase of business was caused by the taking over by his company of the Rosario business. He also observed that last year the company paid 6 per cent. dividend, and had the rate of exchange remained the same, the company would be paying only 5 per cent. in the present year—that was to say, a difference of £7,000 in exchange would have meant 2 per cent. more than they actually received. He further said that the expenses caused by cyclones and that kind of thing ought to be met out of the depreciation and renewal fund. He also asked what had been the rate per cent. of the increase in subscribers from the 1st of January last. He felt sure the directors had done their very best, and that the feeling was shared by the other shareholders was manifest by the smallness of the meeting.

The Chairman replied that while it was true that the Rosario business had been taken into account, apart from that there had been a considerable increase in the Buenos Ayres business. He did not think it advisable to give precise figures of the increase in new subscribers. The increase in the rates of subscription had by no means had the prejudicial effect which some persons anticipated. In circumstances like depreciation of currency there was always increase in the cost of material, and that had seriously told upon the company. While he promised to take note of the observation with regard to charging damage from cyclones to the depreciation and renewal account, he thought they ought to have a strong reserve. This was essentially a time for a cautious policy.

Lord Thurlow and Mr. Fredk. Green were re-elected directors, Messrs. Cooper Bros. & Co. were reappointed auditors, and, with a ote of thanks to the board, the proceedings terminated.

Crompton an d Company, Limited.

THE second annual general meeting of the shareholders was held at the Cannon Street Hotel, on the 21st inst., when the report for the year ending 31st March, 1890 (printed in our last issue), with the accounts, was laid before the meeting.

The Chairman, Mr. R. E. B. Crompton, briefly alluded to the loss the company sustained by the death of Viscount Torrington. That loss was extreme. The deceased had taken an exceedingly keen interest in the company's affairs. When they last met some 1,200 of the preference shares had not yet been placed, but were allotted immediately afterwards. The directors then, in accordance with the terms of the prospectus, applied to the Stock Exchange for a settlement and quotation for the preference shares. These had since been accorded. There had not been many sales in the past year, the apparent explanation being that members did not wish to part with what they believed to be a good dividend paying property. The company's business had increased very largely, and the directors had consequently been compelled to add to the plant at Chelmsford and elsewhere, and to increase the working capital, to do which they had exercised their borrowing powers, and had issued 5 per cent. debentures to the amount of £50,000, which was secured by a deed of mortgage. The whole of the £25,000 of debentures, originally offered, had been applied for, and the directors now proposed to offer the remaining £25,000 for subscription, and a circular would be sent out accordingly. The sum of £6,750, which last year appeared on the balance-sheet as a loan on mortgage of the Chelmsford works, had been paid off, and the debenture debt remained the only charge on the property. The profit for the year was £10,610 1s. 7d., or £2,000 more than the year before, and about £4,000 more than the average of the six years which preceded the formation of the company; a result which might be considered fairly satisfactory. After payment of the interim dividend in December last year, and providing for debenture interest and other charges, and after carrying the sum of £500 to the doubtful debts and contingencies account, there remained a balance of £6,030 6s. available for dividend, and out of this the directors proposed to pay 7 per cent. per annum for the half-year to the preference shareholders, and 5 per cent. upon the ordinary shares, carrying the balance, £474 18s. 10d., forward to the next year. The company's increasing business had necessitated capital expenditure for extension of premises and additions to plant. They had also taken over the portion of the company's Chelmsford property, which was leased to Crompton and Fawkes, and which adjoined the Arc works, and these were immediately available for the extension of the Arc works. During the past year the company had the good fortune to secure very large orders from three most important supply companies—viz., the Westminster, the Kensington, and the Notting Hill, for the fixing of machinery, and the supply and fixing of a complete system of underground mains, extending 40 or 50 miles through the London streets. In the early part of the year they worked with a separate staff taken from the temporary premises of the company's Kensington Court estate. These temporary premises, being no longer available, the directors had thought it advisable to lease the convenient premises, No. 1, Lillie Road, West Brompton, which were being fitted up, and were now the head-quarters of the company's engineering staff in connection with those large West End orders. The principal feature of those orders was that they seemed to offer a fair chance of a good profit, while the risks were not great. As regards other prospects, the company's order books were full for its own special type of large dynamo machines, switchboards, and that class of plant, and the general prospects of orders were better than he, the speaker, had ever known them to be since he entered the electrical business. They might congratulate themselves on the extremely good feeling prevailing between the staff and the workmen. They had succeeded in organising piecework on a more considerable scale than had yet been attempted, without encountering the difficulties which other engineering firms had met with. That was a great deal due to the tact and good management of the Chelmsford managers. The very delicate question of piecework had been the bone of contention which had caused so many strikes all over the country. In the company's case it was a great step in advance, as it enabled it to keep accounts and to know the cost of its work with much greater accuracy than was possible when the bulk of the work was done by day labour. Regarding the accounts, they called for no special remark from him. He therefore moved the adoption of the report and accounts.

The Secretary, in reply to a shareholder, explained that the accounts of the Australian Company were not yet to hand; one of the managers of that company was bringing them over. In the meanwhile they were said to show a very satisfactory profit. The motion was seconded and carried unanimously.

The Chairman moved to declare a dividend at the rate of 7 per cent. per annum for the half year, payable on the company's preference shares, and a further dividend of 5 per cent. per annum upon the ordinary shares. The motions were seconded and carried unanimously.

The Chairman, in moving the re-election of Sir Charles Grant, K.C.S.I., as a director, spoke in warm terms of the services of that gentleman, who became chairman of the company on the death of Lord Torrington. If he, Mr. Crompton, occupied that position to-day, it was because from his intimate connection with the business, he was the best fitted to answer questions. But Sir Charles Grant had been a very powerful and steadfast member of the board, and one whose loss, if he left it, would be greatly felt. The motion was seconded and carried unanimously.

The Chairman, replying to a vote of thanks to the board, said the sole business of his life was to look after the company's interests. The proceedings then terminated.

The South of England Telephone Company, Limited.

THE seventh ordinary general meeting of the shareholders was held at Winchester House, on the 18th inst., at twelve, when the following report for the year ending 30th April, with a statement of accounts, was presented. The expenditure on capital account for the past year amounts to £14,116 2s. 10d., bringing the total of that account to £78,418 2s. The revenue account shows a sum

of £21,549 18s. 9d. for subscriptions and rentals, and a net credit balance of £6,148 5s. 4d., making, with the sum of £627 1s. 2d. brought forward from last year, an available balance of £6,775 6s. 6d. Of this amount the sum of £1,796 14s. 7d. has been absorbed by the payment of an interim dividend on the preference shares at the rate of 6 per cent. per annum for the half-year ending 30th October, 1889. In order to strengthen the position of the company, the directors have considered it advisable to carry £1,000 to the reserve fund; and they now recommend the payment of a final dividend at the rate of 6 per cent. on the preference shares (£2,096 6s. 2d.), for the half-year ending 30th April, 1890, and the payment of a dividend of ½ per cent. on the ordinary shares, free of income tax (£1,500), for the year, leaving a balance of £382 5s. 9d. to be carried forward. The completed trunk lines are as follows:—Brighton—Shoreham; Brighton—Eastbourne; Brighton — Worthing; Shoreham — Worthing; Brighton— Hurst; Brighton—Newhaven; Brighton — Rottingdean; Brighton— Lewes; Lewes — Eastbourne; Canterbury—Ramsgate; Ramsgate—Margate; Ramsgate—Sandwich; Ramsgate—Deal; Canterbury—Faversham; Canterbury—Whitstable; Canterbury—Dover; Dover—Folkestone; Chatham—Maidstone; Norwich—Great Yarmouth; Northampton—Wellingboro'; Wellingboro'—Kettering; Kettering—Rushden; Tunbridge Wells—Tonbridge.

The trunk lines in course of construction are Canterbury—Ashford; Faversham—Sittingbourne.

At the 30th April this year, 2,265 exchange lines and 583 private lines were completed, and 91 exchange lines and 19 private lines were in course of construction.

Telephone exchanges are now open at the following places—Brighton, Cambridge, Canterbury, Chatham, Deal, Dover, Eastbourne, Faversham, Folkestone, Great Yarmouth, Hastings and St. Leonards, Hurst, Hythe, Ipswich, Kettering, King's Lynn, Lewes, Maidstone, Margate, Newhaven, Northampton, Norwich, Oxford, Peterborough, Ramsgate, Reading, Rottingdean, Rushden, Sandgate, Sandwich, Shoreham, Tunbridge Wells, Watford, Wellingborough, Whitstable, Worthing.

Comparative Statement of Exchange and Private Line Business.

	Exchange.	Private.
April 30th, 1886	687	... 248
April 30th, 1887	1,130	... 348
April 30th, 1888	1,521	... 386
April 30th, 1889	1,972	... 500
April 30th, 1890	2,356	... 602

The Chairman (Mr. D. O. Bateson), explained why the report and balance sheet had been delayed. The company's licence from the Post Office was terminable at periods of seven years by six months' notice from the Postmaster-General; and that notice not having been given, the company had a fresh life of seven years. It was thought undesirable that the state of the company's affairs should be published so long as the matter of the licence was uncertain; but after the Postmaster's decision was known no time was lost in presenting a report and calling a meeting. The company's books were, in fact, balanced and its accounts ready for audit six months before the 30th April. The reason why the preference dividend was not paid at the beginning of May, as formerly, was that some of the shareholders doubted the correctness of the former practice. They said that while it was perfectly right to pay an interim dividend on the estimate of profits, it was scarcely business-like to make the final distribution before ascertaining the correct balance. The directors had adopted that view, and propose to continue it in practice. There was no reason to complain of the progress of the company's business. The increase was not very rapid, but it was continuous and steady, considering the somewhat bad pasture. He was sorry the National Telephone Company apparently could not see its way to admitting the company to its system, as the company was thereby debarred from exploiting the most valuable part of its district, namely, that within the 20 miles radius of London. There were many residents and business firms most anxious for this means of communication, which, he thought, could not long be delayed, as it would be extremely profitable to the telephone companies. The trunk line system in East Kent would shortly be completed by the opening of a route between Ashford and Canterbury, which would place the former town in communication with nearly all the business centres and seaside towns in the district. They were indebted to Lord Winchelsea for the grant of wayleaves through Eastwell Park. The cost of wayleaves was increasing, and though, as a rule, they were granted without much difficulty, the directors had occasionally to complain of being squeezed unmercifully. In such cases they preferred to alter the route, if possible, even at considerable extra expense. The rating question was becoming serious for telephone companies, and the question had been raised in many places. In Brighton, the board appealed to the Quarter Sessions against a heavy assessment in vain, and as the parent company would be no party to the expense of an appeal to the Queen's Bench, it had to be relinquished. As regards the accounts, the gross rentals had increased by £3,676; that was about the usual average. This year, however, the shareholders derived no benefit from the improvement, as the auditors stood out for carrying a much larger proportion of the wages and office expenses to revenue than was thought necessary last year. The reserve, it was thought, ought to be increased, as it had not been altered for some years; and, no doubt, the older the company grew, the expenditure necessary for repairs of lines, altering routes, &c., grew also. That, however, the directors provided for in the balance sheet originally submitted; but the shareholders' auditor was resolved that the entire increase for the year should go for maintenance, although the working of the new lines was undoubtedly capital expenditure. The directors still thought so large a sum as £3,758 an unnecessary and inequitable addition to the maintenance fund, but as a clean certificate was refused, and they were threatened with a contentious meeting, they agreed to the inevitable, and left the matter to the shareholders. No doubt the alteration would strengthen the financial position of the company, and though probably the selling value of the ordinary shares would be temporarily lessened to a small extent, the value of the preference shares ought at least to be maintained, as they were a steady and reliable security. He moved the adoption of the report and accounts, and to declare a dividend at the rate of 6 per cent. per annum for the half-year ending April 30th, 1890, on the preference shares, payable the 19th inst., and a further dividend at the rate of ½ per cent. per annum, free of income tax on the ordinary shares, payable on the 19th.

The resolution was seconded by Mr. C. Billett, who, whilst regretting last year's 1 per cent., reminded them that the missing ½ per cent. would go to strengthen the company.

The motion was carried unanimously.

The Chairman, replying to a shareholder, as to negotiations between the company and the National Telephone Company, said that no such negotiations had ever taken place. The directors could do nothing without the shareholders' consent at a general meeting.

A shareholder strongly objected to anything like the company's shares being valued at 5s., as the National Telephone Company appeared to do by their report.

Mr. Bateson was re-elected to the Board, and Mr. J. Weise, the shareholders' auditor, was re-appointed.

With a vote of thanks to the Board, the meeting closed.

The Direct United States Cable Company, Limited.

THE report of the directors for the six months ended 30th June, 1890, to be presented at the twenty-sixth ordinary general meeting of the company, to be held at Winchester House, 50, Old Broad Street, in the City of London, on Friday, the 25th day of July, 1890, at 2 p.m., states:—The half-year's revenue (subject to revision on decision of the case mentioned below), after deducting out-payments, amounted to £40,017 1s. against £39,626 8s. 5d. (after similar deductions) for the corresponding period of 1889, being a difference of £390 12s. 7d. in favour of the half-year under review.

The working and other expenses for the same period, including income tax, but exclusive of cost of repairs of cables, amounted to £17,616 5s. 8d., leaving a balance of £22,400 15s. 4d. as the net profit of the half-year, making, with £8,317 19s. 4d. brought forward from the previous half-year, a total of £30,718 14s. 8d. For the corresponding half-year of 1889 the working expenses and other payments amounted to £16,676 3s. 9d.

Three quarterly interim dividends of 3s. 6d. each per share, amounting to £31,872 15s., have been declared and paid during the financial year, and a final payment of 3s. 6d. per share is now proposed, making, with the three interim dividends, 3½ per cent. for the year, being a total distribution of £42,497. An amount of £8,502 4s. 5d. has been transferred to the reserve fund account, which now stands at £250,000, and the balance of £968 0s. 3d. on the revenue account is proposed to be carried forward.

During the earlier portion of the past half-year the traffic showed a slight diminution as compared with the corresponding period of the previous year, but lately an increase has taken place which it is hoped may be progressive.

The Anglo-American Company having in January last opened offices of its own in New York, the expense of the office at 40, Broadway, in that city, previously maintained as a joint office, is now entirely borne by this company, accounting for the increase in the expenses during the past half-year. The maintenance of an independent office in New York is regarded as necessary.

A station has been opened by this company at 40, Hope Street, Glasgow. These additional facilities are already producing beneficial results.

A break occurred in the short section of cable on January 19th last, about 122 knots from Halifax, which was repaired on March 30th.

On April 10th a fault was removed from the shore end of the same cable near Rye Beach.

On May 26th a break occurred in the main cable which was promptly repaired on the 29th.

The breaks in the cables were found to have been caused by vessels' anchors.

The repairing operations have cost £4,919 13s. 5d., which has been debited to the reserve fund account as heretofore.

The interests of the company were represented at the International Telegraphic Conference recently held in Paris. In the case of the Anglo-American Telegraph Company *v.* Cie. Française du Télégraphe de Paris à New York, the appeal to the Council of State, mentioned in the report to the 30th June, 1889, is still pending. Pursuant to the provisions of the Articles of Association, two of the directors, viz., Charles Meara, Esq., and E. M. Underdown, Esq., Q.C., retire by rotation, and being eligible, offer themselves for re-election.

Mr. John G. Griffiths, F.C.A., and Mr. John Sawyer, F.C.A., the auditors, retire pursuant to the Articles of Association, and offer themselves for re-election.

The Westinghouse Electric Company.

AT a meeting of the stockholders of the Westinghouse Electric Company on July 8th, at the offices of the company in the Westinghouse Building, Pittsburgh, Pa., Mr. George Westinghouse, jun., made a statement to the meeting, in which the following occurs:—The board of directors are of opinion that a total increase in the capital stock of not less than $5,000,000 should now be authorised in order to provide for the future requirements of the company. It is proposed to issue forthwith to each stockholder of record on this date an assignable right to subscribe, on or before August 1st, 1890, for one half share of stock for each share now standing in his name on the books of the company, at $40 per share, this price being determined by a distribution or an allowance from the surplus earnings. Of this price one-quarter will be payable on August 1st, one-quarter September 1st, one-quarter October 1st, and one-quarter November 1st. Mr. Geo. Westinghouse, jun., has agreed to take $1,250,000 of stock on the terms above indicated. If each of the other stockholders will subscribe to the number of shares to which he is entitled, the company will be enabled to provide for a large increase in its business. The board believe it to be to the pecuniary interest of each stockholder to subscribe for his amount of stock, and thereby aid in increasing the earning capacity of the company, which will have the immediate effect of enhancing the value of the shares already outstanding, and of the shares which in this manner will be secured at a reduced rate. The board believed that great profit would accrue to the company by securing foreign patents on the more important of the inventions exploited by it in this country. This policy resulted in an order from the Metropolitan Electric Supply Company, Limited, of London, for a central station of 10,000 lights capacity, which has since been increased to 25,000. The station is now in operation with entire satisfaction, and is the most complete and perfect central station in Europe. A company known as the Westinghouse Electric Company, Limited, has been organised in London, to operate these patents, and this company has received in payment for the patents and the money expended in the development of that business £301,000 of the stock of that company, which is the controlling interest. The English company has recently received orders for other plants, and is in negotiations for others of a very extensive character, with every prospect of success. Indeed, the business abroad bids fair to reach proportions that will equal, if not be greater, than those of the parent company, and to be a source of great profit to it. The majority of the board of the Westinghouse Electric Company, Limited, are also members of the Westinghouse Brake Company, Limited, of London, and the business is being conducted on the same lines which rendered the latter company so successful. Its operations are under the supervision and direction of Mr. H. M. Byllesby, the vice president of this company, who is its managing director, and is now in England giving it his personal attention.

The Mutual Telephone Company, Limited.

A MEETING of the shareholders of the Mutual Telephone Company, Limited, was held on Monday in the Memorial Hall, Albert Square, Mr. A. D. Provand, M.P., in the chair.

Mr. Provand said the first resolution was that the capital of the company be increased to £350,000. The company was registered with £100,000 capital, which was sufficient for Manchester and Liverpool, but they had had so much encouragement in Glasgow—where more than 1,000 firms have signed the preliminary circulars—and also in other places, that they now asked for the capital to be increased sufficiently to allow them to commence operations in other cities. None of this capital was to be asked for in Manchester. They required £45,000 to erect their exchange; more than £40,000 of this had been allotted, and applications were steadily coming in. They had therefore all that was required for Manchester. The second resolution to alter the articles of association, so as to permit them to pay interest up to 10 per cent., instead of being limited to 6 per cent. This alteration was asked for because they had found it difficult to create a company on strictly mutual terms—that was to say, every renter of the company's telephones being a holder of shares in the company. As all the renters were not shareholders, some of them must take an increased number of shares to make up for those who took none, and it appeared 6 per cent. was not a sufficient inducement for these shares to be taken up, nor was it a sufficiently high rate of interest to promise to pay on the business. This would not add much to the working expenses. In their estimate of earnings they put down the 2,500 wires of the Manchester exchange at £5 each, which was the rate to shareholders, but probably 1,500 or 1,600 of their wires would be rented by non-shareholders, who would pay the higher rate of £6. This would add, say, £1,500 or £1,600 to their earnings, and if they paid the full 10 per cent. interest on the 4,500 shares held in Manchester, it would amount to only £1,800 extra interest, which would be almost met by the extra rates for the telephones rented by non-shareholders. They had in Manchester about 650 shareholders, and when all their wires were applied for, they expected the number would be 900, perhaps even 1,000, holding 4,500 shares; and as the strength of the company largely depended on the number of shareholders, everything should be done to increase that number. The resolutions were put to the meeting and carried.

The Edison and Swan United Electric Light Company.

THE directors' report and the accounts for the year ending 30th June, 1890, states the business of the company has resulted in a credit balance of £61,115 3s. 3d. Of this amount £12,371 14s. 7d. has been absorbed by the payment of an interim dividend on the A shares, at the rate of 7 per cent. per annum, for the first six months of the year. The directors recommend the payment of the following dividends on the A shares, free of income tax, and to be distributed in accordance with Clause 87 of the Articles of Association:—

(*a.*) At the rate of 7 per cent. per annum for the half-year ending 30th June, 1890 (making 7 per cent. for the year):

(*b.*) Four per cent. in completion of payment of arrears of cumulative preference dividend for the year ending 30th June, June, 1884:

(*c.*) Four per cent. in respect of arrears of cumulative preference dividend for the year ending 30th June, 1885:

which will absorb £40,649 19s. 3d.; leaving £8,093 9s. 5d., which the directors have carried to the reserve fund, in accordance with Article 89 of Articles of Association. The directors have been adding to the buildings and plant at the factory so as to enable them to manufacture lamps in sufficient numbers to meet the demand which will arise as the supply companies extend their operations in London and other towns. Mr. Shelford Bidwell, F.R.S., retires from the board, and offers himself for re-election as a director. The auditors, Messrs. Welton, Jones and Co. retire, and are eligible for re-election.

The Manchester Edison-Swan Company, Limited.

IN their report for the year ending May 31st, 1890, to be submitted with the accompanying balance-sheet at the meeting of shareholders on the 28th inst., at the Albert Memorial Hall, Manchester, the directors state the net profit, including last year's balance, as £1,647 6s., which they proposes to appropriate as follows:—£1,000 to payment of dividend at 5 per cent per annum, and £647 6s. to balance carried forward. It is proposed to issue the dividend warrants on August 1st, 1890. Mr. W. P. James Fawcus has been appointed managing director, vice Mr. J. R. Williams resigned through ill-health. The retiring directors, Sir Jos. C. Lee and Mr. J. C. Waterhouse, offer themselves for re-election.

The Wendigo Copper Company, Limited.—This company was advertised this week with a capital of £225,000. Of this a first issue of 12,500 shares of £5 each is offered to the public, and a like number of shares will be taken by the vendors in part payment of purchase money. The object of the company is to purchase a large tract of land situate on Isle Royale, Lake Superior, Michigan, U.S.A., amounting in all to about 5,120 acres, and to prosecute mining and the development of its mineral and other resources, which are said to be extensive. The copper is in its pure metallic state, and is termed "native," and the methods of winning it and reducing it to cake and ingot copper are the simplest and cheapest. As the company will have its own harbour and docks on the property, the cost of the transit should be less than from many of the mines on the south shore.

The Eastern Extension Australasia and China Telegraph Company, Limited.—The directors notify that the coupons on this company's 6 per cent. debentures, due on August 1st proximo, will be paid on and after that date at the Consolidated Bank, 52, Threadneedle Street, E.C. Coupons must be left three clear days for examination.

The Cuba Sumbarine Telegraph Company, Limited.—After placing £2,500 to the reserve fund, the directors recommend a dividend at the rate of 8 per cent. per annum for the half-year ended June 30th, leaving £501 to be carried forward.

Anglo-American Telegraph, Limited.—Interim dividend for the quarter: 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, payable on 1st August.

The Eastern Extension Telegraph Company.—It was notified early in the week that telegraphic communication with Australia, New Zealand, and Tasmania is now restored.

The Chemical Carbon Company, Limited.—It has been resolved to wind up the company, Messrs. A. Dowling and Thos. Purberry, of Basingstoke, to be liquidators.

Elmore's Patent Copper Depositing Company, Limited.—The transfer books will be closed till July 28th, inclusive, for the purpose of paying a dividend.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending July 18th, amounted to £4,174.

West India and Panama Telegraph Company, Limited. The estimated traffic receipts for the half month ended the 15th July, are £3,879, as compared with £2,553 in the corresponding period of 1889.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 18th, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,208.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (July 17.)	Closing Quotation. (July 24).	Business done during week ending July 24, 1890.	
£					Highest.	Lowest.
250,000	African Direct Telegraph, Ltd., 4 p. c. Deb. Regd. and to Bearer	100	97 —100	97 —100		
1,549,160	Anglo-American Telegraph, Limited	Stock	50 — 51	50 — 51	50⅜	50
2,725,420	Do. do. 6 p. c. Preferred	Stock	86 — 87	86 — 87	87⅛	87
2,725,420	Do. do. Deferred	Stock	14¼— 14⅝	14 — 14⅛	14⅛	14 1/16
130,000	Brazilian Submarine Telegraph, Limited	10	11⅛— 12⅛	11⅛— 12	12	11⅞
99,000	Do. do. 5 p. c. Bonds...	100	102 —104	102 —104		
75,000	Do. do. 5 p. c. 2nd Series, repayable June, 1906	100	103 —107	103 —107		
63,416	Brush Electric Engineering Ordinary, Nos. 1 to 63,416... ...	3	1⅞— 2	1⅞— 2		
63,416	Do. do. Preference, Nos. 1 to 63,416 ...	2	1⅜— 1⅞	1⅜— 1⅞		
$7,216,000	Commercial Cable, Capital Stock	$100	103 —105	103 —105	103⅛	...
224,850	Consolidated Telephone Construction and Maintenance, Ltd. ...	14/-	¼— ⅜	5/16— 13/16	⅜	...
20,000	Crompton & Co., Limited, 7 p. c. Pref. Shares, Nos. 1 to 20,000	Stock	5½— 5⅝	5½— 5⅝		
16,000	Cuba Telegraph, Limited	10	12¾— 13¼	12¾— 13¼	13¼	12⅞
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18		
12,931	Direct Spanish Telegraph, Limited ... (£4 only paid)	5	3½— 3⅝	3½— 4		
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	9⅜	...
60,710	Direct United States Cable, Limited, 1877	20	10¼— 10½	10¼— 10½	10½	10 5/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14 — 14¼	14 — 14⅛	14 5/16	14 1/16
70,000	Do. 6 p. c. Preference	10	15 — 15½	15 — 15½	15½	15 7/16
200,000	Do. 5 p. c. Debs. (1879 issue), repay. Aug., 1899	100	108 —111	108 —111	108½	...
1,200,000	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 —109	106 —109		
250,000	Eastern Extension, Australasia and China Telegraph, Limited	10	13⅞— 14⅛ xd	14 — 14⅛ xd	14 3/16	14
320,000	Do. 6 p. c. Debentures, repay. February, 1891	100	101 —103	101 —103		
446,100	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. ...	100	103 —106	103 —106		
12,500	Do. 5 p. c. Debentures, 1890, redeem. ann. drawings ...	100	103 —106	103 —106		
367,900	Eastern and South African Tel., Ltd., 5 p. c. Mort. Deb., 1900...	100	100 —103	100 —103		
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	4⅜— 5⅛	4⅜— 5⅛		
46,700	Elmore's Patent Copper Depositing, Ltd., Nos. 23,001 to 70,000	2	5⅞— 6⅛	5⅛— 6	5⅛	5 5/16
19,700	Fowler-Waring Cables, Nos. 301 to 20,000 ...(£3 only paid)	5	2 — 2½	2 — 2½		
180,227	Globe Telegraph and Trust, Limited	10	9⅛— 9⅜	9⅛— 9⅜	9⅜	9 3/16
180,042	Do. do. 6 p. c. Preference	10	15⅛— 15⅜	15⅛— 15⅜		
150,000	Great Northern Tel. Company of Copenhagen	10	15⅜— 16⅛ xd	15⅜— 16⅛	16⅛	15⅜
40,000	Do. do. 5 p. c. Debs. (issue of 1881) ...	100	100 —103	100 —103	101⅛	...
250,000	Do. do. do. (issue of 1883) ...	100	105 —108	105 —108		
9,334	Greenwood and Batley, Ltd., Ordinary, Nos. 4,667 to 14,000 ...	10	12 — 13	12 — 13		
5,334	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	11⅛— 12⅛	11⅛— 12⅛		
41,600	India-Rubber, Gutta-Percha and Telegraph Works, Limited ...	10	18⅛— 19⅛ xd	18⅛— 19⅛ xd	18⅜	...
200,000	Do. do. 4½ p. c. Deb., 1896...	100	103 —105	103 —105		
17,000	Indo-European Telegraph, Limited...	25	37 — 39	37 — 39		
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7		
100,000	Do. do. do. 6 p. c. Debentures ...	100	107 —110	107 —110		
49,900	*Metropolitan Electric Supply, Limited, Nos. 6,101 to 50,000 ...	10	4¼— 4⅜	4¼— 4⅜		
436,700	National Telephone, Limited, Nos. 1 to 436,700	5	5⅛— 5⅜	5 — 5⅛ xd	5 1/16	5
15,000	Do. 6 p. c. Cum. 1st Preference	10	12⅛— 12⅜	12 — 12⅛ xd	12 1/16	12 1/16
15,000	Do. 6 p. c. Cum. 2nd Preference (£8 only paid)	10	10⅛— 10⅜	10⅛— 10⅜ xd		
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11/- only paid)	1	⅛— ⅜	⅛— ⅜		
9,000	Reuter's, Limited	8	7⅞— 8⅛	7⅞— 8⅛	8⅛	...
209,750	South of England Telephone, Ltd., Ordinary, Nos. 1 to 2,000, 2,501 to 3,500, 93,251 to 300,000	1	⅛— ...	⅛— ...		
20,000	Do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 (£3¼ only paid)	5	2⅞— 3⅛	2⅞— 3⅛		
3,381	Submarine Cables Trust	Cert.	112 —116	112 —116		
78,949	Swan United Electric Light, Limited ... (£3½ only paid)	5	5 — 5⅛	5 — 5⅛	5⅜	5⅛
37,350	Telegraph Construction and Maintenance, Limited	12	43 — 45 x	43 — 45 xd	44	42⅞
150,000	Do. do. do. 5 p. c. Bonds, red. 1894	100	100 —102	100 —102		
55,000	United River Plate Telephone, Limited	5	4⅛— 4⅜	4 — 4⅛		
146,000	Do. do. 5 p. c. Debenture Stock... ...	Stock	90 — 94	90 — 94		
100,000	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...		
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	9 — 10 x	9 — 10 xd		
300,000	Do. do. do. 5 p. c. Debentures	100	99 —102	99 —102	100⅜	...
30,000	West Coast of America Telegraph, Limited	10	6 — 6½	5⅞— 6⅛	5⅞	...
150,000	Do. do. do. 8 p. c. Debs, repay. 1902 ...	100	106 —110	106 —110	108½	...
64,572	Western and Brazilian Telegraph, Limited	15	10 — 10½	10⅛— 10⅜	10 5/16	10⅛
26,986	Do. do. do. 5 p. c. Cum. Preferred	7⅛	6⅛— 7	6⅛— 7	6 13/16	...
26,986	Do. do. do. 5 p. c. Deferred	7⅛	3⅞— 4⅛	3⅞— 4⅛	4	...
200,000	Do. do. do. 6 p. c. Debentures "A," 1910...	100	106 —109	106 —109	107⅛	...
250,000	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	104 —107	104 —107		
88,321	West India and Panama Telegraph, Limited	10	2⅜— 2⅝	2⅜— 2⅝	2⅝	2⅜
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11 — 11¼	11 — 11⅛	11⅛	11¼
4,669	Do. ... do. do, 6 p. c. 2nd Preference ...	10	12¼— 13¼	12¼— 13¼		
1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mort (Building) Bonds	$1,000	120 —125	120 —125		
179,300	Do. do. 6 p. c. Sterling Bonds	100	99 —101	99 —101		
42,853	*Westmstr. Elec. Sup. Corp., Ord., Nos. 101 to 42,953 (£2 only paid)	5	1¼— 1⅞	1¼ - 1⅞		

* Subject to Founders Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7⅛—7⅜.—Electric Construction Corporation (£10 paid), 7¾—8¼. Elmore Copper Depositing Priorities, 6¾.—Elmore Wire, ¼ dis—par.—House-to-House Company (£5 paid), 5 —5¼.—London Electric Supply Corporation, Ordinary (£5 paid), 1¾—2⅛.—Manchester Edison and Swan Company, £9, (£1 paid), 11/- —12/-.

BANK RATE OF DISCOUNT.—4 per cent. (26th June, 1890).

REPORT ON THE LINEFF ELECTRIC TRAMWAY SYSTEM.

I HAVE examined and tested the new Lineff Electric Tramway system, with underground conductor, at the depôt of the West Metropolitan Tramway Company, at Chiswick.

The main feature of the new Lineff system is the employment of a conductor placed in a conduit or channel closed on all sides, so that no slot or other opening in the road is required for establishing electrical communication between the generating dynamos at the power station, and the propelling motor on the car. This communication is established by means of short pieces of insulated rail, laid between and parallel with the ordinary tram rails, and a continuous conductor placed below the insulated rails, in a channel or conduit formed of insulating materials. The conductor consists of naked copper strip or cables upon which is laid a strip of galvanised iron. There is a small interval between the upper surface of the iron strip and the lower surface of the insulated or third rail, and the latter is not in electrical communication with the power station as long as this interval is maintained. This is the case on all portions of the line not occupied by cars, and therefore the third rail may, where accessible, be walked upon or touched without the slightest danger from electrical shocks. Immediately under the car, however, two or three sections of the third rail are in contact with the buried conductor, and become thus charged to the potential of the latter. This contact is produced by magnetic action, which draws the iron strip up, and presses it against the lower flange of the short pieces of insulated rail, which thus become part of the conductor, from which the current is picked up by contact wheels and led to the motor on the car. The return circuit is, as usual, through the rails and earth. As the car travels along, the underground iron strip is dropped behind and picked up in front, thus maintaining continuity of connection with the power station over its whole journey, whilst, at the same time, leaving the track in front and rear of the car perfectly free from electrical charges. The magnetic action between the insulated rails and underground conductor is produced by an electro-magnet carried under the car. This electro-magnet is ordinarily energised by a current obtained from the conductor, but it can also be energised by a current obtained from one storage cell, so that the conductor, should it accidentally have been dropped, may be picked up at any point on the line.

The car employed was an open summer car, carrying 20 passengers, besides driver and conductor. I estimate the weight of car, as fitted with a 4 H.P. motor, chain gear, magnetic brake and other accessories, at 35 cwt., without passengers.

The object I had in view when making the tests, of which I give a detailed account in the appendix to this report, was to ascertain whether the Lineff system in its present form is likely to prove successful in practical work. The answer to this question depends mainly upon three considerations, viz., safety to the public, efficiency of service, and economy of working. I deal with these considerations separately.

SAFETY TO THE PUBLIC.

The car, when running at full speed, can be stopped within a distance of 9 feet, or less than its own length. This power of control is amply sufficient for practical purposes. There remains the further question, whether there is any danger of persons or animals receiving shocks from stepping upon the insulated rails in front or behind the car.

The length of an ordinary car is 21 feet, so that the nearest accessible point of the insulated rail is about 11 feet from the centre of the car. My experiments lead me to conclude that the charged region of the insulated rail can, at all speeds, be restricted to within about 9 feet in advance and behind the centre of the car, leaving 2 feet of rail under the car at either end, and all the rail beyond the ends free from electrical charge, so that there is no danger of persons or animals receiving shocks from the rail.

The collection of current from the magnetic rail is so arranged as to avoid sparking.

EFFICIENCY OF SERVICE.

I found the magnetic picking-up gear perfectly reliable, both on the straight single line and on a branch or crossing. I have already mentioned that as a further precaution against losing the current each car will be equipped with a storage cell for picking up, and there will thus be no danger of a car losing its propelling power and blocking the road.

ECONOMY OF WORKING.

Compared with a car worked by an overhead line, the present Lineff car will require from ¼ to ½ of a horse-power more, but as electric tramways on the overhead wire system are inadmissible for urban and suburban traffic, the comparison must be made either with an underground slot system or with cars propelled by storage batteries. As regards the former, there is no perceptible difference in power between it and the closed magnetic channel system. With storage cars, the power required is however considerably in excess of that required with the closed magnetic channel, for the simple reason that, in addition to weight of car, motor, and passengers, the weight of the storage cells must also be taken into account. With the Lineff system 7½ horse-power will be required to propel a full-sized car at 7 miles per hour. To propel the same car by storage batteries would require carrying an additional weight of 3 to 4 tons, and an expenditure of about 12 horse-power. Making due allowance for the loss of power in charging and discharging the storage cells, I find that the total amount of steam power required at the station would, with storage cars, be about double that required by the Lineff system.

NOVELTY.

With regard to the novelty of the Lineff magnetic conductor, I may add that although magnetic action has been used before by several inventors for actuating switches which establish electrical contact between a sealed main and separated lengths of surface rails, yet the idea of a continuous magnetic conductor forming, so to say, one single switch for the whole line, is entirely novel and strikingly simple. The arrangement of magnetic rails on the hit and miss principle is also entirely new, and secures a great economy in the energy necessary to effect the attraction of the continuous magnetic conductor.

This part of the invention especially has been worked out with great skill and care, as is amply testified by the good results obtained under the very unfavourable conditions imposed by the necessities of road traffic and by other mechanical considerations. The fact of having one set of magnetic rails only exposed on the surface, each length in turn becoming of north and south polarity, is novel, and will greatly help the adoption of this system in preference to those where two sets of exposed rails are required to close the magnetic circuit. The arrangement of blind rail, which performs the same office as if it were on the surface of the road and under the direct influence of the magnet pole, is very ingenious and effective.

The mechanical strength of the magnetic channel and of the line generally, was tested by taking a steam roller over it. The line was not damaged thereby in any way, either mechanically or electrically, and I consider the result of this test highly satisfactory.

As a general result of my investigation, I have come to the conclusion that the Lineff closed magnetic channel system is now ripe for practical application.

(Signed) GISBERT KAPP.

–, Parliament Street, Westminster,
June 12th, 1890.

APPENDIX TO REPORT.

The tests upon which my report is based were made on the 29th and 30th of May, and the 3rd, 10th and 11th of June, 1890.

I deal in this appendix with the various points in the same order in which they occur in the report.

SAFETY TO THE PUBLIC.

The extent of "charged region" on the insulated rail was tested in the following manner:—The positive lead feeding the glow lamps on the car was disconnected from the main positive terminal, and connected to a flexible conductor terminating with a contact piece or pilot brush. The latter was attached to a wooden bar which could be set so that contact was made with the insulated rail at any given distance from the centre of the car. When the point of contact was on a charged or "live" rail the lamps lighted up; when on a "dead" rail they remained dark. By varying the distance of contact it was thus easy to ascertain the extent of the charged region on either side of the centre of the car. I found that the length of charged region varies at different points of the line, which may be due either to a variation in the thickness of the hoop iron (this being of two different gauges on the line), or to a variation in the thickness of its zinc coating, which, if too thin, would not allow the hoop to drop instantly. I also found that there was some uncertainty in the lamp test if the contact between the pilot brush and live rail lasted only a fraction of a second. In such cases the lamp filaments had not time to become so hot as to be distinctly visible, and I replaced in subsequent tests the lamps by an electric bell, which gave indications with contacts of so short duration as to escape detection by the lamp test. The result of these tests, which were made at various speeds, and over a continuous piece of line 68 feet long, are given in the following table.

Extent of Charged Region behind the Centre of the Car.	Speed in Miles per Hour. 1	3	7
7 feet 6 inches	live ...	live ...	live
8 „ 3 „	live ...	live ...	live
8 „ 6 „	live ...	live ...	live
9 „ 0 „	dead ...	dead ...	dead
9 „ 6 „	dead ...	dead ...	dead
10 „ 0 „	dead ...	dead ...	dead

There remained still the question whether the wave running along the hoop iron under the car might induce subsidiary waves in it at greater distances than 10 feet from the centre, either in front or behind the car. If this were the case, there would be danger of the magnetic rail becoming "alive" at points when ordinary traffic passes over it. I have tested this question by short-circuiting the magnetic rail to earth at various distances both in front and behind the car, and whilst the latter was running and standing, and in no single case have I found a "live" section of magnetic rail.

I also investigated the question whether it will be possible to collect the current from the magnetic rail without sparking, as otherwise horses might be frightened. In the original management, the collection of current was effected by the contact of the wheels supporting the electro-magnet on the magnetic rail, and with a dry and clean line, or with a dirty and wet line, there was no perceptible sparking. If, however, the line, when dry, was

covered with dry sand, gravel, and clinkers, there was sparking, and to avoid this defect, I advised Mr. Lineff to fit wire brushes to the pole shoes, so as to obtain more perfect contact. This has been done, and in a subsequent test no perceptible sparking occurred with any condition of line.

EFFICIENCY OF SERVICE.

The efficiency of service depends upon the power required to propel the car, and upon the possibility of maintaining the line in proper working order. As regards the power required for the car itself, apart from that absorbed by the apparatus for collecting the current, there is no reason why the Lineff car should require either less or more power than any other electric car of equal weight, and geared to run at the same speed. I have therefore only to investigate what extra amount of power is absorbed by the apparatus for collecting the current, and what amount of power is lost by underground and surface leakage.

The power required for the current collecting apparatus may be regarded as lost to propulsion, and this loss consists of three items:—

1.—*Imperfect Contact between Magnetic Rail and Wheels of Electro-Magnet.*

I measured the difference of potential between the magnetic rail and the car terminal when the working current of 11 ampères was passing. The drop of E.M.F. thus found varied with the condition of the line. It was ·3 of a volt when the line was watered, but otherwise clean; ·7 when the line was clean and dry; and 2·7 when the line was dirty with mud, horse dung, sand and clinkers. These tests were all made before the brushes above mentioned had been fitted, so that with the improved contact this loss of power may be considered as insignificant.

2.—*Power Required to Energise the Electro-Magnet.*

The resistance of the two magnet coils and a third external coil is 220 ohms, and the working pressure 230 volts. The power absorbed in the three coils is therefore $\frac{230}{220} 230 = 240$ watts, of which 160 watts are required for the magnet and 80 watts wasted in the external coil. These 80 watts could be saved by rewinding the two magnet coils with finer wire. The energy expended in "picking up" is therefore 160 watts.

I had previously tested the magnet and found that 60 watts is the minimum of energy required for picking up, but to make sure of always maintaining the circuit, 160 watts have been allowed. During my test of the line, there has been no case of failure to maintain the circuit.

3.—*Power Required to Propel the Electro-Magnet.*

This was tested by hauling the magnet alone along the line, a spring balance being inserted into the hauling rope. I found the resistance to be 19 lbs. when the magnet was not energised, and 27 lbs. when it was energised. At seven miles per hour this represents an expenditure of about half a horse power. It appears desirable that this loss of power should be reduced, which can be done either by employing larger wheels and improved axle bearings on the electro-magnet, or by so suspending it from the car, that part of its weight is taken by the car.

In the workshop there has been erected a full size working model of the magnetic rail as arranged for a switch or branch line. After the tests on the line on the 30th May were completed, the electro-magnet was detached from the car, taken into the workshop, and run over the magnetic rail containing a branch line. The current-collecting apparatus acted perfectly, and there was no failure to maintain the circuit either on the main or on the branch line.

ECONOMY OF WORKING.

I have now to consider the amount of power lost by underground and surface leakage. The former takes place over the whole length of the line, and is independent of the number of cars in use at any time, whilst the latter is confined to the three charged sections of magnetic rail under each car, and is therefore proportional to the number of cars in use at any time. The insulation resistance of the conductor was tested both by the bridge method (48 Leclanché cells, Post Office pattern bridge, and mirror galvanometer), and by passing the leakage current through a voltmeter. The two methods gave fairly accordant results, but the insulation varied on different days considerably. The highest reading I recorded by the voltmeter test, when the full pressure of 230 volts was on the conductor, was 5,400 ohms, and the lowest 3,550 ohms. In order to maintain the underground conductor in a proper working condition, I consider it desirable and possible to increase its insulation resistance. But for the determination of loss of power by leakage, I take the figures as I find them, disregarding any future possible improvements in insulation. From these figures it appears that the average insulation is 4,475 ohms. Since the line is 220 feet long, the insulation resistance of one mile of similar line will be 186 ohms. Assuming the working pressure to be 300 volts, the leakage current would be 1·61 ampères, and the power thus lost would be 482 watts, or about two-thirds of a horse-power. This loss in itself is not an important item. It is, in fact, negligible in comparison with the power which is required for the propulsion of the cars on a mile of line.

Another source of loss of power in electric traction is surface leakage. To ascertain this, I also applied the voltmeter test, and found the following insulation resistances of three charged sections of magnetic rail. With the line clear and moist, 4,183 ohms with the line very wet and covered with mud and horse droppings, 980 ohms. Taking 2,000 ohms as an average, I find that at a working pressure of 300 volts, the loss of power by surface leakage per car amounts to 45 watts, which is quite insignificant.

As regards the question whether it will be possible to maintain the line in proper order when subjected to the wear and tear of ordinary street traffic, I am of opinion this can only be decided by actual trial extending over a considerable time. As far as it was possible to do so, in an experiment extending over a few days, I have tested the line both as regards mechanical strength and insulation. I have already mentioned that the resistance varied between 5,400 and 3,350 ohms during the time over which my experiments extended. An average insulation of 4,475 ohms per 220 feet, or 186 ohms per mile, would not be too low if the only consideration were that of the waste of power entailed by leakage, but experience shows that when the insulation of a line is initially low, there is probability of its becoming still lower in the future, and for this reason I consider it desirable to improve the insulation of the line. I am of opinion that this can be done in two ways—first, by an alteration in the shape and arrangement of the earthenware supports of the conductor, and, secondly, by blowing dry air through the channel. This will necessitate the employment of air compressor at the power station, but the additional capital outlay and working expenses will be trifling in comparison with the advantages of good insulation, which will be obtained thereby. The mechanical strength of the closed channel was tested by taking a steam roller both across and along the line. Since the magnetic rail is slightly higher than the running rail and surrounding pavement, the whole weight on one of the driving wheels of the steam roller (which I estimate at 5 tons) was thus supported by the magnetic rail. The steam roller was driven backwards and forwards, over and across the magnetic rail, to see whether any mechanical damage could thus be done to it. I could not detect any deformation or other damage done to the magnetic rail or the bitumen channel, and, so far, the steam roller test was entirely satisfactory. There remained still the possibility that, through the application of a concentrated pressure of 5 tons, minute cracks, invisible to the naked eye, might have been developed which would admit moisture, and thus impair the insulation. To test this point, I had the line drenched with water, but, as shortly afterwards it began to rain, I discontinued the artificial application of water. The rain lasted on and off during the remainder of the day and following night, and in the afternoon of the following day I had the insulation of the line again tested by my assistant. He reported 3,400 to 3,800 ohms. Before taking the steam roller over the line the insulation was 3,400 ohms. If the mechanical strain had developed cracks in the bitumen, there would have been sufficient time for water to percolate in the interval of 26 hours which elapsed between the two resistance tests. Since, however, the second test showed the same if not a higher insulation than the first, it is evident that no damage was done to the line by the steam roller, and I consider the result of this test very satisfactory.

(Signed) GISBERT KAPP.

31, Parliament Street, *June 12th*, 1890.

THE ELECTRIC LIGHT AT BATH.

SEVERAL deputations from representative bodies in London and the provinces have visited Bath to inspect the electric light works and the public arc lamps. A serious leak which occurred on the night of the 8th inst. affected more or less 40 out of the 81 public lamps. Directly the leak was discovered, steps were taken to localise its position, but, owing to the very short nights, this was not completed until nearly the time for ceasing lighting. In reporting the mishap to a committee of the Town Council, Mr. Massingham wrote: "The leakages that I have discovered so far are due to the movable connections between the underground mains and the lamps for the purpose of raising and lowering the lamps and so dispensing with ladders. Major Cardew, R.E., recently inspected the whole of the electric installation on behalf of the Board of Trade, and appeared extremely well satisfied with it as a whole, but suggested that it would be impracticable to make the raising and lowering arrangements absolutely safe, and advised my adopting fixed lamps and conductors and using ladders to reach them, which would be far more reliable from an electrical point of view. As the practical experience of the past fortnight confirms his views, I have decided to dispense with all movable arrangements, and have given instructions to Messrs. Callender & Co., who laid the underground mains, to carry this out with all possible speed. The work is now in hand and, I hope, will be finished within three weeks." The letter was regarded as satisfactory. The Christopher Hotel is lighted by means of electricity from the Bath Electric Light Works. The light is also being introduced into the York House Hotel.

Accumulator Question in Paris.—The adoption by the Northern Tramway Company in Paris of the the Société Française d'Accumulateurs Electriques system has been followed by an order for 40 more cars.

THE COMPOUND WINDING DYNAMO MACHINES.

KING, BROWN & Co. *v.* ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION.

IN the Court of Session, Edinburgh, on Wednesday, the 16th inst., the First Division disposed of a reclaiming note in the above case. It was originally brought in the Outer House by King, Brown & Co., Rosebank Electric Works, Edinburgh, against the Anglo-American Brush Electric Light Corporation, London and Edinburgh, for reduction of letters patent granted to Mr. Brush in 1878 for the exclusive right of making dynamo-electric machines of the compound winding type. Lord Trayner, in the Outer House, found that Brush's patent, having been anticipated by Varley, was invalid, and he, therefore, decided the case in favour of the pursuers, with expenses. The defenders reclaimed to the First Division of the Court, and the case was heard before the Lord President, Lord Adam, and Lord McLaren. Judgment on the reclaiming note was given on Wednesday.

Lord MCLAREN said: The defenders, the Brush Electric Light Corporation, claim under their patent the exclusive privilege of making dynamo-electric machines, in which the electro-magnets are of the type known as "compound wound" magnets; also known as the "series shunt" type. The pursuers, King, Brown and Co., are makers of "compound wound" dynamos; and their right to make such machines having been extrajudiciously challenged they have brought this action to have the defenders' patent reduced and declared void on various grounds; the chief objection being that the invention of compound winding was previously discovered and made known by Mr. Varley, and consequently that Mr. Brush, or his assignees, are not in the position of being the "first and true inventors" of this valuable electric appliance. There can be no doubt that the holders of Brush's patent claim compound winding as an essential feature of their machine; and, accordingly, if this claim be ill-founded, the patent must fall. The argument was directed mainly to the question of the anticipation of the Brush system of compound winding by Mr. Varley, and I shall consider this subject in the first place, touching afterwards on the objections to Brush's specification, which are of a technical character. In order to make my observations intelligible, I must begin by stating in what compound winding consists:—When the armature of an electro-magnet is attached to an axis, so as to be capable of rotating in the magnetic field, the armature tends to place itself in a symmetrical position with reference to the poles of the magnet, and if force is applied to turn the armature on its axis, the movement of rotation is resisted by the forces in the magnetic field. The energy expended by the steam power, or whatever power is employed to turn the armature against the resistance of the magnetic field, is then converted into current electricity; and the current being carried through the revolving axis by insulating wires, is given off by an appliance termed the commutator, passes thence into a conducting wire, and is then ready to be used for electric lighting, or any other purpose of utility to which it is capable of being applied. In the rudimentary form of the dynamo machine, I understand that the excitation of the electro-magnets was maintained from a separate, or, as it is termed, an external source, generally a battery of some kind. The first improvement consisted in winding one of the conducting wires round the electro-magnet, the continuation of this wire being led into the external or working circuit. In this way the current flowing from the dynamo was made to maintain the magnetism of the electro-magnets as a part of the work which it had to perform. This is known as series winding, because there is one continuous current which is only partly used in maintaining the magnetism. The next improvement consisted in dividing the current as it flowed from the commutators into two partial currents. In this system the wire is bifurcated; one branch is wound round the electro-magnet, and is returned to the opposite poles of the commutator. The second branch wire is employed for lighting or external work of some kind, and is reunited to the first branch wire near where it meets the commutator at the opposite pole. This is the form known as the shunt winding system, or shunt machine. The invention of compound winding, with which we are here concerned, consists in, I will not say a combination of the two methods, but in the addition of the shunt and series method. The wire is divided or bifurcated as it leaves the commutator. Both the branches are wound round the electro-magnets. One of these is directly returned to the opposite pole of the commutator without doing any work other than the excitation of the magnets. The second wire, on leaving the electro-magnets, is continued to form the external or working circuit, and is ultimately re-united to the first wire. This arrangement seems to be an exception to the rule against trying to do two things at the same time, because it is admitted that the compound wound machine is a much better working machine than the shunt. It appears that the sections of the wires can be so proportioned that an early uniform current flows in the working field, notwithstanding variations in the quantity of work to be done. It is not necessary for the purposes of the case to explain why this should be, and if it were necessary, I am not sure that I am able to explain it. It is a question of the mathematical theory of current electricity. But it is agreed that the compound wound machine, when the wires have the proper relative conducting capacity, gives better results as regards uniformity and steadiness of the current than are attained by either the series or the shunt, and this explains the importance of the right to use this invention to the parties concerned. I may here observe it is not clear to me that either Varley or Brush were at first fully aware of the scientific and practical importance of the principles of compound wiring. Varley was the inventor, or one of the inventors, of the "series" machine, and both Varley and Brush were doubtless aware of the advantages and disadvantages of the "series" and the "shunt." The idea of introducing the two methods into the same machine is one that would very naturally occur to any one familiar with the subject, and practically conversant with dynamo machines. Assuming that this is intelligently done, with the object of getting a better working machine through the union of the series and the shunt than is attainable by either of these modes of winding singly, then the invention is a proper subject of a patent, and it is not necessary to its validity that the patentee should have foreseen all these advantages which have been realised through the subsequent introduction or extension of electric lighting with the incandescent lamp. I may also observe that in Brush's specification, as well as in this specification, the mode of winding is only treated as one among many other parts of a dynamo machine; and it is quite possible that a reader, even if conversant with the subject, might peruse either of these documents without having his attention specially called to the novelty of the system of compound winding. But neither will this consideration affect the question. An inventor may describe his invention clearly without proclaiming it as a very important discovery, and the question is whether compound winding is clearly described in Varley's specification. The specification in question is No. 4,905 of 1876, and its title is—"Improvements in apparatus for producing the electric light, parts of which invention are applicable to other purposes." The alleged anticipation is contained in the two paragraphs, page 4, lines 11 to 21—"Part of the electricity developed by the machine is diverted to maintain the magnetism of the soft iron magnets, and the remaining portion is used to produce the electric light." I interrupt the reading to remark that in the words I have read the writer only announces what he is going to do, and does not profess to be explaining his method. This obvious, and I should have thought, superfluous criticism disposes of many pages of evidence in which witnesses are brought to say that these words would not give them a clear idea of the method of winding. The specification proceeds—"There are several well-known ways of doing this" (that is, of diverting a part of the electric energy developed by the machine), "but the method I prefer is to wrap the soft iron magnets with two insulating wires, one having a larger resistance than the other. The circuit of larger resistance is always closed, and the circuit of less resistance is used for the electric light." If the description had stopped here I should not have doubted that it contained a clear description of the *construction* of a compound wound machine—I mean a description of so much of the apparatus as is included in the name compound winding. The direction is to wrap the magnets with two insulated wires. It is, of course, implied that these wires are to carry currents coming from the machine; but this is not left to implication, because it is clearly explained that these insulating wires are the media for the transmission of separate currents, the one of larger resistance being always closed (in other words, acting as a shunt); while the other is used for the electric light (having previously contributed to the magnetisation of the magnets by being wrapped around them). But if the description had stopped here it would have been open to the observation that while it described the construction it did not indicate, except in a very general way, the use of the compound winding of the magnets. Now, I could hardly consider that to be an adequate description of an invention which should leave the reader in ignorance of its utility and its mode of action. But the information which I desiderate is supplied by the second paragraph: "When the electric light is being produced the greater portion of electricity passes through the circuit of less resistance, which I term the 'electric light circuit,' maintaining the magnetism of the magnets, and producing the light. When the electric light circuit is open from any cause, the electricity developed passes through the circuit of greater resistance only, and maintains the magnetism of the magnets." There is here plainly described one of the advantages of the compound wound dynamo, probably the only one known to the writer, viz., that when work is being done in the external circuit, the magnets have the benefit of the unobstructed flow of the electric current through the wire of larger resistance and less resistance, while when the external circuit is open and no work is being done, the magnets receive through the wire of greater resistance the current which is sufficient for their excitation. I am here merely paraphrasing Mr. Varley's description without meaning to add anything to it, and I think that anyone conversant with the subject, and reading this paragraph (whether he agreed with Mr. Varley or differed with him as to the possible benefits to be obtained), would not be left in doubt as to what Mr. Varley considered to be the *rationale*, and the mode of action of the arrangement of wires described in the preceding sentences. I have difficulty in understanding how it is that a considerable number of able and distinguished men should have been persuaded to give their evidence as to the alleged insufficiency of Mr. Varley's description as an anticipation. To a considerable extent the evidence of the witnesses of the Brush Company is made up of somewhat minute and verbal criticism on the expressions used by Mr. Varley. But, in so far as these gentlemen indicate an opinion as to the insufficiency of the description in its entirety, I think their conclusions are, in part, explained by their having misapprehended the question, because I observe that

the question is frequently asked, and answered, whether Varley's specification is such as would enable an ordinary workman to make a compound wound machine. Now the question of anticipation does not depend (in our opinion) upon that test. We are not here trying the sufficiency of Varley's specification as a specification. Varley is not here claiming any exclusive privilege (his patent has long since expired), and we have no occasion to consider whether he fulfilled the duty which is the counter-part of the exclusive privilege given to a patentee of particularly describing and ascertaining the nature of his invention, and the manner in which it is to be performed. I am very far from saying that Varley's specification is insufficient as a specification of a patented invention. I rather think it would be held to meet the requirements of the statute of King James. But the question we are now considering is quite different: it is whether Mr. Brush is or is not the first and true inventor of compound winding; and the negative of that proposition may be proved by showing that the invention was previously described, not necessarily in language sufficient as a direction to a mechanic; but in language clear and intelligible to educated men conversant with the subject, and capable of giving the necessary directions to the hypothetical workman. An invention may be clearly described in mathematical or chemical symbols; the latter being, perhaps, the preferable illustration. Such a description, although it may have to be translated for the instruction of the operative chemist (just as if it were written in a foreign language) would be an anticipation of the same invention described in popular language, such as is required (as far as practicable) by our Patent Law. Now I venture to think that if Varley's description had been put into the hands of any of the defenders' witnesses (without reference to any question under the Patent Laws) that he would have understood it, and would have been able to instruct a workman to make an experimental machine. I think I can collect from their evidence that the witnesses on both sides understood the specification perfectly, although some of them were certainly apprehensive that other persons, less gifted, would not find it so easy to be understood. It is a remarkable circumstance in this case that neither in the course of the trial, nor in the argument addressed to us, has any reference been made to Brush's description of compound winding. It seems to have been assumed that it, at least, was a pattern of clearness, and certainly no objection was taken to it on the ground of insufficiency. Brush's description is contained in the following passage in his specification:—"In applying my invention to dynamo-electric machines, I wind the cores of the field magnets with a suitable quantity of a comparatively fine wire, having a high resistance in comparison with that of the external circuit, and the rest of the wire in the machine. The ends of this wire are so connected in the other parts of the machine, that when the latter is running a current of electricity constantly circulates in said wire, whether the external circuit be closed or not. The high resistance of this wire prevents the passage through it of more than a small proportion of the whole current capable of being evolved by the machine; therefore the available external current is not materially lessened. When this device, which I have called a 'teaser,' is used in connection with field magnets, also wound with coarse wire for the purpose of still further increasing the magnetic field by employing the main current for this purpose in the usual manner, then the 'teaser' may be so arranged that the current which passes through it will also circulate in the coarse wire, thus increasing the efficiency of the device." Now if Varley's description be insufficient, I do not see how the validity of Brush's patent can be maintained, because the two descriptions are practically identical. Conversely, if the invention of compound winding be well described in Brush's specification, the identical description in Varley's specification must be an anticipation. I do not mean, of course, that the language of the two descriptions is absolutely identical. In describing the shunt arrangement, Brush calls it a "teaser" (I do not know whether electricians attach any significance to this vocable), and there are some other variations of expression. But I can find nothing of substance in Brush that is not in Varley, and I cannot help adding that if there be any difference Varley's description is the more easily understood of the two. This completes what I have to say on the subject of anticipation by prior publication. There is also a plea of anticipation by prior use. On this point the facts are these:—In the interval between the filing of the provisional and complete specifications Mr. Varley had a machine made to his direction by the firm of Siebe and Gorman. When the machine was first tried it did not work well, because its frame was not sufficiently strong to prevent the revolving armature being attracted into contact with the electro-magnets. I need not say that the motion of the armature must not be resisted by friction, but only by the immaterial, though not less real resistance offered by the forces developed in the magnetic field. This was corrected by strengthening the frame, and the machine was successfully used in the production of an arc light by the lamp produced along with the machine. Siebe and Gorman are makers of diving apparatus, and the lamp was used on their premises to exhibit the apparatus under water in a tank which they had for the purpose. The case on public use is narrow, but we consider that what I have described is public use as interpreted by decisions. The machine in question was produced, and it is a compound machine; nobody has said anything to the contrary, though some of the defenders' witnesses say that if the wires were uncoupled, or were coupled up in a difficult way, it would no longer be so. But the effect of uncoupling the shunt wires would be to render this part of the winding simply useless for any purpose, as would indeed be the case with a machine of any kind if a material part of the mechanism is taken out of its place or turned the wrong way. The Lord Ordinary has, in his judgment, extracted some of the more noticeable expressions of opinion by the scientific witnesses on the questions of prior publication and prior use, and has pointed out the insufficiency of the reasons given for holding Varley's specification to be incorrect or incomplete. I concur in the Lord Ordinary's view as to the weight to be attached to this part of the evidence, and, in his lordship's opinion, generally on the facts of the case, except in so far as he may be held to imply that the test of the sufficiency of an anticipation is the same as the test that would be applied to the construction of a specification founded on as such. There is another objection to the defenders' patent, and it is founded on an alleged inconsistency between the provisional and the complete specifications. The provisional specification announces, as one of the improvements for which the patent is granted, an improved construction of the commutator. The function of the commutator is to convert the alternating currents (as they pass from the revolving axis to the external circuit) into one continuous current. This is accomplished by fitting the axis with insulated segments, to which the poles of the armature are connected by insulated wires, and these segments are so arranged that at the moment when the current in the machine is reversed, the external wire becomes disconnected from the corresponding segment, and is at the same time brought into connection with the segment which is attached to the opposite pole of the armature. The improvement indicated in the provisional specification is a purely mechanical improvement for the purpose of obtaining a mechanical advantage. But, in the course of perfecting his invention, Mr. Brush found that an electrical advantage might also be secured by means of a slight variation of the mechanical arrangement indicated in the provisional specification. The variation consists in separating the segments, so that for a small fraction of each semi-revolution the current shall be interrupted; that is to say, the current is cut off during the brief interval when the armature (or the particular member of the compound armature) is in a neutral position, and when the resultant of the forces acting on it is therefore very small. In the complete specification, the variation whereby this electrical advantage may be gained is claimed as one of the patented improvements, and the question arises whether this difference between the provisional and complete specifications does not exceed the latitude allowed to an inventor who is only perfecting what he has provisionally announced. The Lord Ordinary has held that the claim referred to is not covered by the provisional specification on the ground that, although the construction of the commutator as perfected is not materially varied, yet, as the variation represents a distinct principle, and is directed to an object distinct from that which is indicated in the provisional specification, the two things cannot be regarded as identical inventions. There is much force in the Lord Ordinary's view on this question; but we consider it unnecessary to come to a decision upon it, because we are all of opinion that if there had been no more serious objection to the Brush patent than this, it would be only fair to the patentee that he should be allowed an opportunity of disclaiming this variation on one of the patented improvements. But this is not the condition of the case as it arises for decision, because we are agreed that the patent is invalidated in its essential and fundamental privilege by reason of the prior publication and prior use by Varley of the invention of compound winding, for which this exclusive privilege is given. For these reasons I am of opinion that the interlocator of the Lord Ordinary should be adhered to, and decree of reduction of the patent pronounced.

The LORD PRESIDENT: That is the opinion of the Court.

On the motion of Mr. DANIELL, counsel for King, Brown and Co., the Brush Corporation were found liable in expenses.

PROCEEDINGS OF SOCIETIES.

The Institution of Electrical Engineers.

"Observations on Currents originating in ordinary Aerial Telegraph Conductors,"* by A. R. BENNETT, Member.

All users of telephones connected by single wires are familiar with the variety of noises which are generally present, even when the line is only a few hundred yards long. It is exceptional to find a wire which can be said to be even approximately silent at all times. The origins of some of the foreign currents which the presence of these noises indicates, have been explained by Preece, Lockwood and others. Recently in testing some overhead copper and iron wires run on the same poles for capacity by charge and discharge, using a sensitive reflecting galvanometer, the author noticed the presence of currents which could not be accounted for by any of the known explanations, and the causes of which he determined to investigate.

It was noticed that soon after the commencement of rain, a steady current appeared on all the wires under test. The deflections increased as the rain continued, until, after the thorough soaking subsequent on several days' wet, they were in some cases no

* Paper read at the special meeting of the Institution of Electrical Engineers, held in the Lecture Hall, Edinburgh International Exhibition, July 15th, 1890.

longer within range of the scale. A constant discrepancy in the behaviour of copper and iron wires was apparent. The deflections from the copper were always positive, while those from the iron were always negative, and as invariably much feebler, seldom exceeding one-third the strength of the positive ones.

To ascertain the cause, two wires, one No. 12½ copper, and the other No. 11 galvanised iron, run side by side on the same arms for the distance of a mile (fig. 4) were taken. In fine weather the insulation resistance of each was infinite.

When disconnected at the farther ends and earthed at the home end through the reflecting galvanometer (fig. 1), they always in wet weather exhibited the phenomena described.

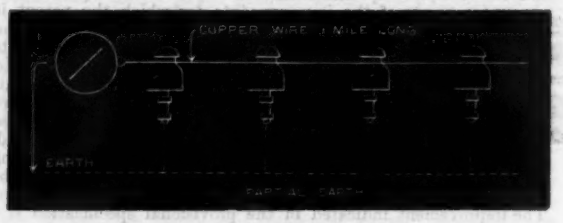


FIG. 1

The following are extracts from the records of tests extending over several months, during medium and heavy rain :—

Copper.—Always positive.		Iron.—Always negative.	
Degrees.	Value of deflections in milliamperes.	Degrees.	Value of deflections in milliamperes.
4·5	·0030375	1·5	·0010125
13	·008775	3·75	·00253125
20·5	·0138375	4	·002700
17	·011475	3	·002025
15·	·010125	4·5	·003037½
3·	·002025	·5	·0003375
46·	·031050	17·5	·0118125
22·	·014850	7	·004725
14·5	·0097875	3·5	·0023625

It will be observed that the copper deflections were always from three to six times stronger than the iron ones. When the copper and iron wires were left insulated at their distant ends, and looped through the galvanometer (fig. 2), earth being excluded, the positive and negative deflections were always equal. Thus, taking the last three of the foregoing tests, when looped 46 + 17·5 − became 35 + 35 − ; 22 + 7 − became 12·5 + 12·5 − ; 14·5 + 3·5 − became 9·7 + 9·7 −.

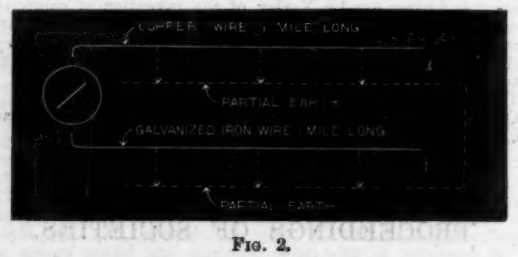


FIG. 2.

Half-a-dozen insulators with galvanised iron bolts were mounted on an arm in the testing room, and thoroughly wetted (fig. 3). With a copper wire run on them, and the bolts connected, as shown, a positive current appeared as soon as a film of water was established between the wire and the bolt. With an iron wire instead of the copper no current appeared.

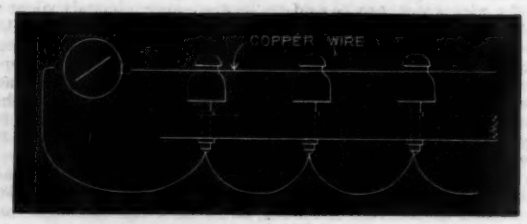


FIG. 3.

The positive current, therefore, seemed to be due to voltaic action between the copper wire on the insulators and the galvanised iron bolts supporting them when connected with the moist surface. The course of the current can be traced in fig. 1. The wire and insulator bolts form a series of voltaic cells joined in parallel.

The absence of a current from the iron when mounted on the experimental arm confirmed this conclusion, since no current was to be expected under the conditions. But whence, then, the negative current from the iron wire run on the actual poles? In that case it had a copper wire strung alongside it (fig. 4). The wetting of both insulators established the connection necessary for electrolytic conduction between them, so that the metals constituted a voltaic couple, the negative current from which appeared on the iron.

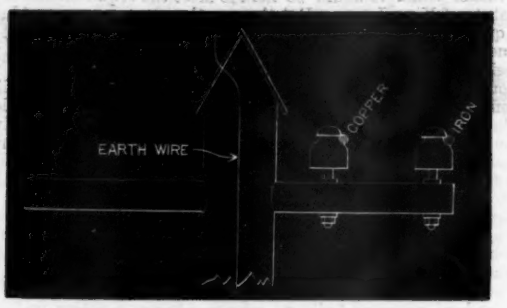


FIG. 4.

The positive current on the copper was consequently due to the copper wire acting with the iron bolts of its own insulators, the iron bolts of the neighbouring insulators and the iron wire which they supported.

The negative current on the iron was due to the iron wire, its bolts, and the bolts of the neighbouring insulators, acting with the copper wire. But the bolts of the insulators (fig. 4) were partially earthed by the damp wood of the poles and the earth wires which ran down them. If the earth had been perfect no current could have got to the galvanometer, but since it was only partial some found its way by that route; and so the difference in strength between the positive and negative currents is accounted for.

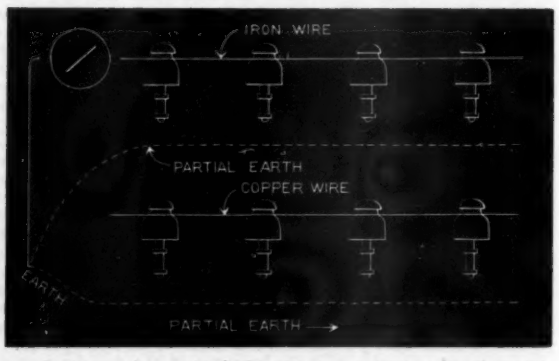


FIG. 5.

The positive, depending chiefly on the action between the copper wire and its own bolts, between which no earth intervenes, is necessarily stronger than the negative, which depends wholly on the action between the iron wire and bolts and the copper wire between which a partial earth is interposed (fig. 5). So when the earth is cut off from the galvanometer (fig. 2), the effect of the earth between the two plates is neutralised, and the positive and negative deflections become equal.

A somewhat unexpected effect of the recent introduction of copper wires for telegraph and telephone purposes is consequently the establishment over the country of a vast number of voltaic couples, which only become operative in damp or wet weather.

The zinc of the bolts of insulators carrying copper and bronze wires may reasonably be expected to disappear sooner than in days gone by when only iron wire was used; and when copper and iron wires are run on the same poles the galvanising of the iron must suffer sooner than of yore.

The Americans, with the wooden pins, will escape the currents due to the difference of metal between the wire and its supports; but when they mix wires of different metals on the same poles the resulting action will be stronger than with us, since they do not earth-wire their posts.

Telephonically, the existence of these currents is of little moment. With metallic loops when both wires are of the same metal, they will not matter at all, since the currents from two similar wires will be in the same direction and of the same strength, and, meeting in the telephone or translator will neutralise one another.

On single wires, so long as the currents remain steady, their presence does not matter much. As they increase gradually as the insulators become wet, and die away slowly as they dry, they

do not give rise to any disturbance in the telephone. If any confirmation of the voltaic origin of these currents were needed, it would be afforded in the fact that it is possible by changing the line from a battery, to polarise the line couple even to the extent of obtaining temporary currents of the opposite sign. Thus, the copper was repeatedly changed from a 90-volt battery; when from the positive pole the line current was increased, when from the negative the line current was decreased and sometimes reversed.

The following are particulars of several tests of the copper wire, the deflections being in degrees:—

Charging wire from 90 volts, &c., to line so as to neutralise and overcome line current.

Line current.	Duration of charge.	Result.
·5 +	10 seconds.	Reversed to ·2 −
·6 +	20 seconds.	Reduced to 5 +
8·4 +	4 minutes.	Reduced to 3·5 +
12·5 +	10 seconds.	Reversed to ·2 −
	Spot went back instantly to 5 +, and then recovered slowly to 12·5 +	
12·5 +	20 seconds.	Reversed to ·4 −
	Went back quickly at first, and then slowly recovered to 12·5 + in 45 seconds.	
12·5 +	1 minute.	Reversed to ·8 −
	Went back instantly to 3·5 +, recovering slowly to 12·5 in 70 seconds.	
12·5 +	2 minutes.	Same as 1 minute.
12·5 +	3 minutes.	Same as 1 minute.

The same effects were produced with the experimental arm. With only one insulator, reversed, the cup being full of water and the surface well wetted, a deflection was got of 4 degrees, equal to ·0027 milliampères. When the current from this insulator was reduced to ·2 + through the surface drying, a reversal could always be obtained to ·4 −, and sometimes to ·6 −, by charging it from 90 volts −.

During the capacity tests already mentioned, it was observed that for some time after the commencement of rain, the apparent capacity of the wire invariably rose, instead of falling with the decrease of insulation. This effect has, of course, been noticed before, but, as the author was not aware that it had been satisfactorily accounted for, it was resolved to investigate, and the result of the investigation seems to point to several contributory causes. Firstly, no doubt, the line current due to the voltaic action already described will increase or diminish the discharge according to the direction of the charging current. Secondly, the polarisation of the bolts due to the charging current will have the same tendency. But the capacity of the line will appear too high when the moisture on the insulators is too slight to permit of voltaic action. To seek the cause of this, 12 feet of copper wire was run on six dry insulators fixed in oaken arms in the test room. With 90 volts the wire gave a discharge of ·4 degree. The tops of the insulators around the binding wire were wiped with a wet sponge. The discharge then rose to 1 degree, more than double. Wetting more of the surface of the insulators resulted in a still further increase. Several discharges could be got without renewing the battery charge. It would, therefore, appear that wetting the insulators is equivalent to an increase of conductor surface. The moisture has to be charged as well as the wire, and the consequent discharge is greater than with a dry wire. The effect is only observable in moderate rain, or for some little time after the commencement of heavy rain, when the insulators become thoroughly wet the insulation and the capacity fall together, and then the voltaic action and polarisation come into play together with another phenomenon which has not yet been referred to.

Incidentally, in the course of these tests, it was found that when a wire is in contact with moist wood, and is charged from a powerful battery (90 volts were used), the discharge is several times stronger than when the same wire is supported on dry or partially moist insulators. Thus a length of wire on insulators gave a discharge of ·9 degree; when fastened along an oaken arm not sensibly damp, with staples of the same metal as the wire, the discharge, after 20 seconds charge amounted to 4·5 degrees, and after 80 seconds to 5 degrees. Then a residual charge appeared to remain in the wood, as the wire continued to yield a current of ·5 degree for some minutes, then gradually dying away to nothing.

FIG. 6.

Many tests, varied in details, gave the same results; 30 feet of wire in air gave a discharge of ·4 degree. When the same wire was stapled on a deal board (fig. 6) not sensibly damp, the discharge became 3·5 degrees, falling immediately to 1 degree, and then slowly to zero. The wire and the wood were then sponged and the discharge rose to 7 degrees, falling immediately to 2 degrees, and returning slowly to zero. The wire yielded a series of smaller discharges for several minutes without any fresh contact with the battery. A deal box wetted, having some bronze wire in contact with it, was well insulated by being suspended by G.P. Charged for 20 seconds from 90 volts, it gave a discharge of 1·6 degrees, sinking immediately to ·8 degree, and then gradually to zero. The same box standing on the floor, gave a discharge, under the same conditions, of 12 degrees, sinking to 3 degrees, and then slowly to zero. The same box touched by the end of an earth wire—also of bronze—well away from the bronze wire, gave a discharge of 45 degrees, sinking immediately to 26 degrees, and thereafter slowly to zero. In the two first cases only one metallic conductor, that is to say, the bronze, through which the charge was communicated, was present, and the source of the return current is not very apparent.

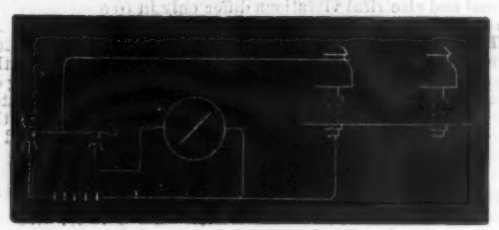


FIG. 7. A.

The last case closely resembles a wet telegraph pole, the earth wire of which does not touch the bolts. Then an expanse of wet wood intervenes between the bolts and the earth, and a powerful charging current in the line must, with leaky insulators, result in back currents. As it is evident that moisture in wood has the effect of increasing the capacity, it may not be unreasonable to deduce that moisture in the air surrounding the wire may have the same effect.

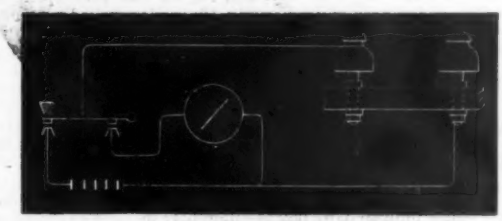


FIG. 7. B.

The foregoing particulars apply whether the line is of copper or of iron; the following observation applies to iron alone.

It has been mentioned that no current between a galvanised iron wire on a wet insulator and the bolt could be detected. But if such a wire is charged by 90 volts, the discharge is followed by

FIG. 8.

a counter current from the insulator. The effect can be produced with a few inches of galvanised iron wire and a wet insulator, as in A, fig. 7. Charging such an arrangement by 90 volts yielded a discharge of ·4 degree and a counter current of ·3 degree, which did not wholly disappear for some three minutes. Obviously, the polarisation of the bolt following on electrolysis of the moisture made the insulator a secondary battery. The effect of damp wood may be markedly shown by shifting the return wire to the bolt of an adjoining insulator as in B, fig. 7. The discharge then became 1·5 degrees, and the counter current 1 degree, an augmentation of nearly four times.

Connecting the earth wire direct to the bolts will obviate the effect of moist wood, but it increases the strength of the voltaic action and the polarisation of bolts by the charging current.

Although the Americans escape the voltaic action consequent on the use of metallic bolts, the damp wood of their poles cannot be without its effect in wet weather with the insulators they use.

The current set up between copper wire and iron bolts in wet weather might be used to signal with. The experiment has not been tried, but it seems plain that a galvanometer at A, fig. 8,*

* There is no lettering on the drawing sent to us.—EDS. ELEC. REV.

through which the line current circulates in its full strength when the wire is insulated at B, would be affected by the working of a key between the line and earth at B, for the key, when closed, would shunt a large proportion of the current away from the galvanometer.

It will be observed that these experiments were made with the distant ends insulated, a condition which does not obtain in ordinary telegraphy. The practical effect of the disturbances noted may be insignificant, especially with double current working, but still it is well to know that they exist.

Note.—Since reading the paper it has occurred to the author that the probability of this conclusion—that aimed at in paragraph commencing "The last case closely resembles"—is strengthened by considering that dry and moist air have very different capacities for heat. Tyndall found that the absorption of heat by dry air being 1, that of the air of his laboratory, not specially damp, was 72, while that of air designedly moistened was no less than 90. Thermal and electrical vibrations differ only in frequency, so that some common absorptive action in respect to air may be looked for. The heat absorbed by the moisture in the air is, after the withdrawal of the source of heat, radiated or discharged, not instantly, but gradually, just as the electrical charge, after the cutting off of the battery, is parted with slowly and by degrees, as indicated by the residual charge. It may be expected, therefore, that the apparent capacity of a conductor will be least when contained in artificially dried air.

"The Working Efficiency of Secondary Cells." By W. E. AYRTON; C. G. LAMB, E. W. SMITH and M. W. WOODS, Associates. Read at Edinburgh, Wednesday, July 16th.

(*Continued from page* 82.)

VI.—RESULTS OBTAINED WITH AUTOMATIC APPARATUS.

Many preliminary experiments having been made with the automatic apparatus, we succeeded in making it work quite satisfactorily by the beginning of May, 1889, and it was adjusted to charge five accumulators, A (fig. 5), with a steady current of 9 ampères until the P.D. reached 2·4 volts per cell, and to discharge them with a steady current of 10 ampères until the P.D. fell to 1·6 volts per cell. After 12 days and nights had been spent in continuous charging and discharging, the cells reached a normal state, the time rise of P.D. in charging and the time fall in discharging being at length repeated over and over again, so that when the time curves were drawn for the successive charges they exactly coincided, and so for the discharge curves. The areas of these curves—reckoned, of course, from the zero of P.D., which is much below the figure as here shown—may thus be said to give the "working watt-hours" for charge and for discharge when the charge and discharge are effected between limits of 1·6 and 2·4 volts per cell. Fig. 6 shows the discharge curves obtained on May 16th, 17th, 18th and 19th, the points for each of the discharges being indicated by points differently marked as stated on the figure; and fig. 7 shows the intermediate charge curves obtained on May 17th, 18th, and 19th. Integrating these curves, we find—

Discharge.		Charge.		Percentage Working efficiency.	
Ampere-hours.	Watt-hours per cell.	Ampere-hours.	Watt-hours per cell.	Quantity.	Energy.
115	221·8	117	256·2	98·3	86·5

Soon after this very concordant set of results was obtained, the time of charging, which had remained steadily at 13 hours from the commencement of May, began to increase to 15¼ hours, while the time of discharge only increased half an hour—that is, to about 12 hours. At first we thought that we had been trying to charge the cells too much, so we stopped the charging when the P.D. per cell rose to 2·35 volts; but the time of charging still continued to increase, until at last it rose to 24 hours, the time of discharge still remaining about 12 hours. On again reducing the P.D. limit on charging, the P.D. per cell now refusing to rise to 2·35 volts, both the times of charging and discharging became very irregular, and at length the time of charging suddenly fell to 10 hours and the time of discharging to 6. On carefully examining the plates, they were found to have badly scaled, and to have suddenly become partially short-circuited; they were therefore carefully scraped, and the mud allowed to settle at the bottom, where, in consequence of the special construction of the 1888 cell, it could remain without short-circuiting the plates. Only a few plugs fell out in this operation. This sediment was afterwards weighed and analysed, showing a composition that will be referred to in Section VIII., on the chemical action.

We now concluded that we had been running the cells too low, and we therefore decided to stop the discharge when the P.D. per cell fell to 1·8 volts, retaining the higher limit of 2·4 volts per cell to limit the charge. It is interesting to notice that Dr. Louis Duncan and Mr. H. Wiegand, in their paper on "The Inherent Defects of Lead Batteries," read before the American Institute of Electrical Engineer, and which we saw for the first time at the end of June, 1889, reprinted in the *Electrical World*, come to exactly the same conclusion—that the discharge should be terminated at 1·8 volts per cell, otherwise there is a formation of white lead sulphate and a rapid depreciation of the cell. From what we have since seen, we think that the discharge should be stopped even still sooner—when the P.D. per cell has reached 1·9, or 1·85 volts at the lowest.

We therefore adjusted the automatic interruptor to stop the discharge when the P.D. per cell was 1·8 volts, and the immediate result of this was to bring the time of charging up to 12¼ hours, and to bring up the time of discharging to 10¼ hours. After continuing the charging and discharging continuously day and night for 13 days, the cells reached a perfectly steady state. Curve 8 shows the time fall of P.D. per cell in the discharges finished in the early morning of June 19th, recommenced in the night of June 19th, and again commenced late on June 20th, all the three discharges being so precisely similar that they can be represented by one curve; and, similarly, curve 9 shows the intermediate chargings on June 18th, 19th, and 20th, which were also exactly like one another. The times of the three discharges and of the three charges were, respectively, in hours and minutes—

TIMES OF SUCCESSIVE

Discharges.	Charges.
10 h. 10 m.	11 h. 38 m.
10 h. 10 m.	11 h. 37 m.
10 h. 11 m.	11 h. 37 m.

showing to what an absolutely definite state cells arrive after a definite cycle of charge and discharge between fixed limits has been repeated continuously without interruption for some weeks.

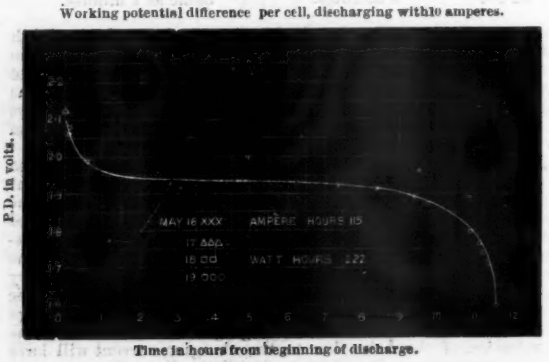

Working potential difference per cell, discharging with 10 amperes.
P.D. in volts.
Time in hours from beginning of discharge.

FIG. 6.

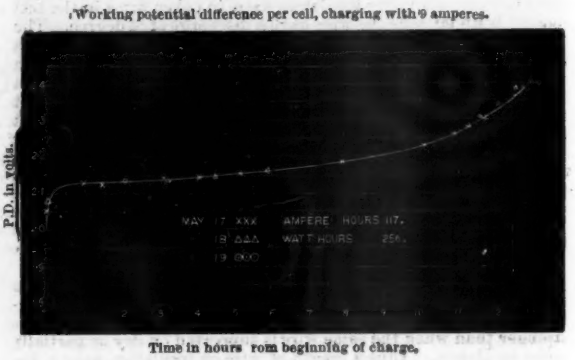


FIG. 7.

Integrating these curves, we find—

Discharge.		Charge.		Percentage working efficiency.	
Ampère-hours.	Watt-hours per cell.	Ampère-hours.	Watt-hours per cell.	Quantity.	Energy.
101·9	201·7	104·5	230·7	97·2	87·4

The numbers contained in this last table may probably be considered as giving the steady working values for this size and type of cell. 230·7 watt-hours are equivalent to 612,200 foot-lbs., and as the positive and negative plates of one cell weigh 28 lbs. 10 oz., the *working* storage capacity is 21,380 foot-lbs. per lb. of plate.

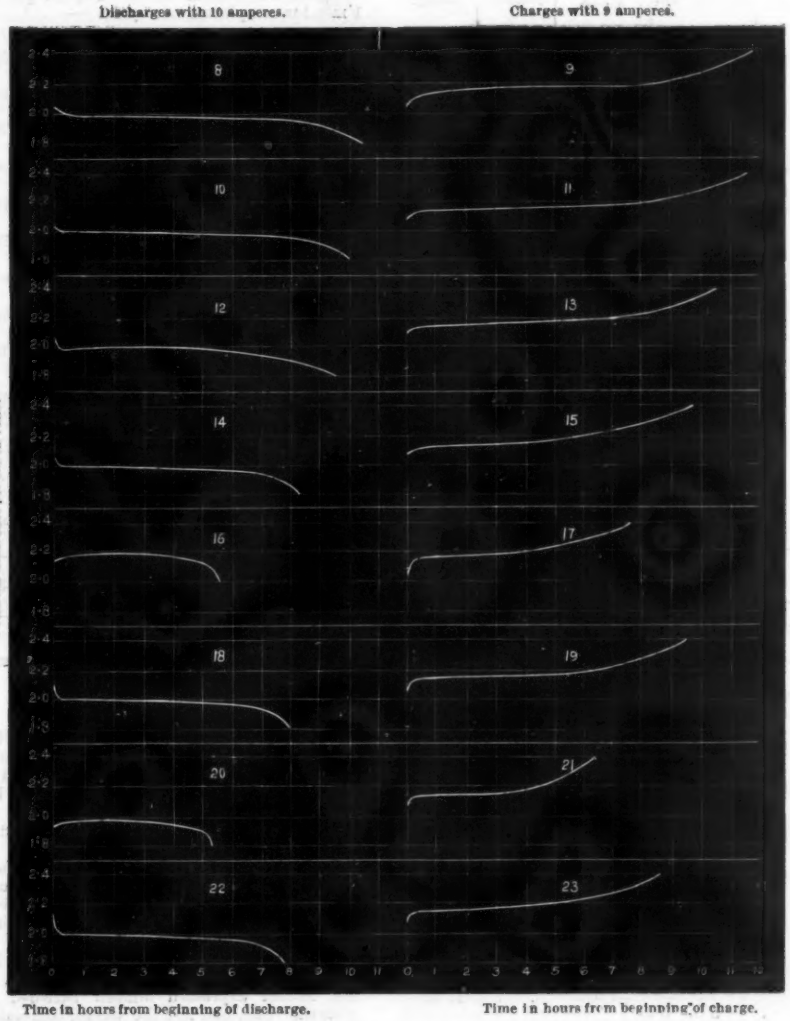
VII.—EFFECT OF REST.

We next tried the effect produced on the capacity and efficiency of accumulators by prolonged rests. The five cells used in the experiments stood on porcelain insulators containing resin oil; and as the insulators, which were specially made for the Central

Institution, were taller than those commonly employed to support accumulators, and as all connecting wires were removed from the cells while they were allowed to rest, it is certain that any change in the cells must have been caused by internal action, and could not have been due to external leakage.

The cells, having been fully charged on June 22nd, were allowed to rest, insulated as above described, until July 2nd—that is, for 10 days. The first few curves of discharge and charge after the rest showed a considerable diminution in capacity and efficiency; but after one week's continuous charging day and night a steady cycle was reached, the following being the times of successive discharges and charges, the limiting P.D.'s, as before, being 1·8 and 2·4 volts:—

Discharges.	Charges.
9 h. 3 m.	10 h. 41 m.
9 h. 2 m.	10 h. 44 m.
9 h. 10 m.	10 h. 51 m.



TIMES OF SUCCESSIVE

Discharges.	Charges.
10 h. 1 m.	11 h. 35 m.
9 h. 59 m.	11 h. 30 m.
9 h. 58 m.	11 h. 32 m.
9 h. 57 m.	11 h. 33 m.

Curves 10 and 11 show the variation of the P.D. per cell, and on integrating these curves we obtain—

Discharge.		Charge.		Percentage working efficiency.	
Ampère-hours.	Watt-hours per cell.	Ampère-hours.	Watt-hours per cell.	Quantity.	Energy.
100	198	103·8	228·2	96·4	85·8

Rest, then, of an accumulator, although left well insulated and fully charged at the commencement, alters the accumulator so that for the first few charges and discharges after the rest it is a much less valuable instrument than before. A week's continuous charging and discharging day and night, however, removes this effect to a great extent; the efficiency, however, still remains somewhat lower than before the rest.

Next, the cells were allowed to rest charged for 12 days, until August 1st. The first discharge at the end of the rest gave a quantity efficiency of only 80 per cent., so that 20 per cent. of the charge was lost. After a week's continued charging and discharging between the former limits of volts, the cells regained a steady state, but the time of charge and of discharge is now less than before this second rest. The times after the week's charging and discharging were—

Curves 12 and 13 show the P.D. curves when the cells had acquired a steady state, and on integrating them we find—

Discharge.		Charge.		Percentage working efficiency.	
Ampère-hours.	Watt-hours per cell.	Ampère-hours.	Watt-hours per cell.	Quantity.	Energy.
91	176·7	96·8	213·2	94·1	82·8

We see, then, that a week's continuous charging and discharging of these cells is unable to compensate for the harm produced by their being left for 12 days fully charged. The two rests of 10 days and 12 days respectively, although followed in each case by a week's continuous charging and discharging, have reduced the discharge ampère-hours by 10 per cent., the discharge watt-hours by 12 per cent., the quantity efficiency by 3 per cent., and the energy efficiency by 5 per cent.

Third Rest.—The cells having been fully charged, a third rest of 16 days took place. On the first discharge, at the normal rate of 10 ampères, the ampère-hours were only 75. After, however, the charging and discharging at the normal rates had been continued for three days and nights, the times of discharging and charging became steady.

Times of Successive	
Discharges.	Charges.
8 h. 12 m.	9 h. 28 m.
8 h. 17 m.	9 h. 35 m.
8 h. 19 m.	9 h. 35 m.

and curves 14 and 15 show the working values of the P.D. in discharging and charging. Integrating the curves, we obtain—

Discharge.		Charge.		Percentage working efficiency.	
Ampère-hours.	Watt-hours per cell.	Ampère-hours.	Watt-hours per cell.	Quantity.	Energy.
82·6	161·3	86·2	190·5	95·8	84·7

Fourth Rest.—The cells, having been fully charged, were allowed to rest for 16 days. Curve 16 gives the values of P.D. obtained at the *first discharge*, and curve 17 the values of the P.D. obtained immediately afterwards in charging. Integrating the former curve, and comparing its area with the area of the charge curve (15) obtained just before the rest, we find—

First discharge after rest.		Last charge before rest.		Percentage efficiency.	
Ampère-hours.	Watt-hours per cell.	Ampère-hours.	Watt-hours per cell.	Quantity.	Energy.
56·5	110·5	86·2	190·5	65·5	58

If, however, we compare the result of the first discharge after the rest with the first subsequent charge, shown in curve 17, we find—

First discharge after rest.		First charge after rest.		Percentage efficiency.	
Ampère-hours.	Watt-hours per cell.	Ampère-hours.	Watt-hours per cell.	Quantity.	Energy.
56·5	110·5	71·1	158·3	79·6	69·6

The cells were now continuously, without intermission, charged with the normal current of 9 ampères, and discharged with 10; the discharge, as before, being automatically stopped when the P.D. per cell had fallen to 1·8 volts, and the charge when it had risen to 2·4 volts. The following give the successive times in hours and minutes in which the cycles were completed:—

First discharge after rest	5 h. 40 m.	
		First charge, 7 h. 54 m.
Second „ „	7 h. 6 m.	
		Second „ 8 h. 30 m.
Third „ „	7 h. 31 m.	
		Third „ 8 h. 51 m.
Fourth „ „	7 h. 29 m.	
		Fourth „ 8 h. 52 m.
Fifth „ „	7 h. 43 m.	
		Fifth „ 9 h. 17 m.
Sixth „ „	8 h. 0 m	
		Sixth „ 9 h. 24 m.
Seventh „ „	8 h. 5 m.	
		Seventh „ 9 h. 17 m.
Eighth „ „	7 h. 57 m.	
		Eighth „ 9 h. 20 m.

From the last three discharges and charges we see that the cells have arrived at a steady state, and curves 18 and 19 show the steady, or working, values of the P.D. for these three discharges and charges. Integrating the areas of these two sets of curves, we find—

Discharge.		Charge.		Percentage working efficiency.	
Ampère-hours.	Watt-hours per cell.	Ampère-hours.	Watt-hours per cell.	Quantity.	Energy.
80	156·9	83·8	184·6	95 5	85

Fifth Rest.—The cells were now left charged for a further period of 16 days. Curve 20 gives the values of the P.D. obtained at the first discharge after the rest, and curve 21 the values of the P.D. obtained immediately afterwards in charging. Integrating the areas of these curves, we have—

First discharge after rest.		Last discharge before rest.		Percentage efficiency.	
Ampere-hours.	Watt-hours per cell.	Ampere-hours.	Watt-hours per cell.	Quantity.	Energy.
53·3	104·1	83·8	184·6	63·6	56·4
		First charge after rest.			
		58·5	128·3	91·1	81·1

Continuous charging and discharging with the normal currents between the normal limits of P.D. per cell gave the following times for completing the cycles:—

First discharge after rest	5 h. 20 m.	
		First charge, 6 h. 30 m.
Second „ „	6 h. 18 m.	
		Second „ 7 h. 29 m.
Third „ „	6 h. 42 m.	
		Third „ 7 h. 59 m.
Fourth „ „	6 h. 54 m.	
		Fourth „ 8 h. 19 m.
Fifth „ „	7 h. 15 m.	
		Fifth „ 8 h. 20 m.
Sixth „ „	7 h. 16 m.	
		Sixth „ 8 h. 30 m.
Seventh „ „	7 h. 23 m.	
		Seventh „ 8 h. 41 m.
Eighth „ „	7 h. 34 m.	
		Eighth „ 8 h. 44 m.
Ninth „ „	7 h. 40 m.	
		Ninth „ 8 h. 47 m.

It was concluded from the times of the last three charges and discharges that the cells had acquired a steady state, and curves 22 and 23 show the time fall and the time rise of P.D. Integrating the areas of these curves, we have—

Discharge.		Charge.		Percentage working efficiency.	
Ampère-hours.	Watt-hours per cell.	Ampère-hours.	Watt-hours per cell.	Quantity.	Energy.
76	149·5	78·3	173·2	97·1	86·3

(To be continued.)

LEGAL.

Stanley and Davies v. Milner and Co.—This case came on for hearing at Manchester last week before Mr. Justice VAUGHAN WILLIAMS and a Common Jury.—The plaintiffs, who are engaged in business as electrical engineers, sought to recover from the defendants, who are bleachers and finishers at Pendlebury, £136 for goods sold and work done. Mr. Fleming appeared for the plaintiffs, and the defendants were represented by Mr. Yates. Counsel for the plaintiffs stated that, on the 6th of June, 1889, negotiations were commenced between the parties for the lighting of the defendants' works by electricity. On the 7th of August, a contract was made by the plaintiffs to do the necessary work. An installation consisting of 46 lamps was accordingly placed in the works, and the illumination was so complete that Mr. Milner expressed himself satisfied with it. When the plaintiffs' men had left the works, complaints were made by the defendants to the effect that the installation was working improperly. The plaintiffs went to see what was the matter, and made the necessary repairs. They, however, found that a man was in charge of the installation who knew nothing about it, and that the defendants' workpeople did not take due care of the machinery for producing the electricity. Under those circumstances it was natural that the installation should go wrong. The plaintiffs repaired a number of lamps which appeared to have been broken by negligent means, but eventually refused to undertake further supervision of the plant unless they received a proper order from the defendants. The installation only consisted of 46 lamps, and of these not more than eight had been the subject of complaint. The defendants had pleaded that the whole installation was useless to them, and refused to pay the amount claimed by the plaintiffs, with the exception of £42 10s., the price of an engine, which amount they had paid into court. Mr. Thomas Stanley, one of the plaintiffs, gave evidence bearing out the statement of counsel. In answer to Mr. Yates, he said that if acid vapours floated about the works and got inside the lamp holders they would corrode the metal. All the main branch wires were cased with wood, and he contended that the wires were fit for electric lighting purposes. He was not aware that electricity escaped to such an extent that no fire office would insure the works.

Other witnesses were called for the plaintiffs, whose evidence went to show that the installation worked satisfactorily when completed. The machinery, however, was not duly cared for, and the result was that after the plaintiffs had left the works the

plant began to work irregularly. Some of the wires also became corroded, owing to the aciduous vapours that floated about the works.

Counsel for the defence submitted that the contract with the plaintiffs was to fit a bleachworks with an electric installation—"the wire to be of the best insulation, and of the highest conductivity of copper." The work was to be done in the best possible manner, and to be fit for a bleachworks. It was admitted in the plaintiffs' case that the wire inserted was not "of the best insulation and the highest conductivity of copper." That was a material point, because the fact that corrosion ensued showed that the material could not have been of the highest kind, or that it was fitted in the best possible manner.

The JUDGE said that, on the contract as it stood, it was extremely doubtful whether the sellers of the machinery contracted to supply machinery suitable with reference to the peculiarities of bleachworks. The whole question of the case was whether the plaintiffs were bound to supply machinery suitable with reference to the peculiarities of bleachworks. He should ask the jury whether the machinery supplied was fitted for bleachworks generally. It was really common ground, and it was tolerably clear that the failure of the machinery was due to corrosion of the wires and holders, in consequence of the presence of steam and aciduous vapours. The whole question of the case was whether the plaintiffs were bound to supply machinery which should afford protection against these vapours.

Mr. H. MILNER, one of the defendants, said the process of bleaching carried on by the defendants was the ordinary one. The installation by the plaintiffs never worked satisfactorily, and occasionally paraffin lamps had to be resorted to.

Mr. E. W. COWAN, an electrical consulting engineer, said he had examined the electrical machinery at the defendants' works. The failure of the plant was due to corrosion of the fuse wire. The wire laid was not of "the best insulation and highest conductivity of copper." The corrosion of the fuse wire caused a leakage of electricity, and the firm in that case ran a risk of fire.

Mr. FAWCUS, manager for the Edison and Swan Company, considered the wire not only unfit for bleach-works, but altogether unsuitable for electric lighting.

The JUDGE said he proposed to ask the jury the following questions:—(1) Was the machinery delivered according to contract, apart from its suitability for user in bleachworks? (2) Was the machinery delivered according to contract, assuming that the plaintiffs contracted to supply machinery suitable for user in bleachworks? (3) Was the machinery wholly useless, or only defective? If only defective, at what sum did they assess the defect?

Mr. YATES said he thought it was assumed that the machinery was useless, otherwise he should have asked the two scientific gentlemen he had called whether it was absolutely bad.

Mr. FLEMING said the plaintiffs only complained of eight lamps out of 46 being defective.

The JUDGE remarked Mr. Yates was at liberty to recall one of his witnesses.

Mr. FAWCUS (re-examined) said he should not like to say that the machinery was useless, or to put any value upon it.

The JUDGE: What would be the most prudent thing for a man to do with that installation in your opinion? Would you take it out and get a new one, or alter it so as to get rid of the present defects?

Mr. FAWCUS: I should certainly take it out and get a new one. The present dynamo might be used again, but new wiring is absolutely essential.

Mr. FLEMING having addressed the jury on the evidence,

The JUDGE summed up.

After a brief absence, the jury returned a verdict for the plaintiffs for the amount claimed, and judgment was entered accordingly.

International Cable Company.—The petition for the winding up of this company, which has been before the Court on several occasions, was resumed before Mr. Justice Stirling.

Mr. HASTINGS, Q.C. (with him Mr. Grosvenor Woods), said the petition was presented by a contributor upon the ground that the substratum of the company was gone, and after the case had been very fully argued in May last, his lordship came to the conclusion that it was not absolutely certain that the Portuguese concession, which was the substratum of the company, was gone, more especially as it was suggested that the Portuguese Government might have revived it, and accordingly directed the petition to stand over until to-day. An affidavit had been made by Mr. Rochs and Sir Alexander Armstrong on behalf of the company, but from this affidavit it was clear that the substratum was gone, and that there was no more chance of the concession being got now than there was of a gold mine being got by the company. What these gentlemen stated was this—that Senor Carilho, who seemed to be very friendly with everybody, including the Portuguese Government, had a great chance of getting a new concession between Lisbon and the Azores, and they also thought it was extremely probable that if he got it he would be ready to part with it to the company for a very moderate sum of money, and they were also sanguine that the necessary capital would be subscribed. Therefore, this affidavit clearly proved that the old concession was gone, and that the capital was absolutely insufficient for working either the old or new concession. Under these circumstances, he submitted that the petitioner was entitled to a winding up order.

The further hearing was adjourned until to-morrow.

NEW PATENTS—1890.

10508. "Improvements in electrical railways and tramways." J. HOPKINSON. Dated July 7.

10515. "An improved connector for the electrodes and cells of primary and secondary electrical batteries." A. J. JARMAN. Dated July 7. (*Complete.*)

10527. "Improvements in magneto-voltaic and static electrodes." E. S. D'ODIARDI and A. THOMPSON. Dated July 8.

10528. "Improvements in electric atomizers." E. S. D'ODIARDI and A. THOMPSON. Dated July 8.

10529. "Improvements in pneumo-dynamometers." E. S. D'ODIARDI and A. THOMPSON. Dated July 8.

10530. "Improvements in liquid electrodes." E. S. D'ODIARDI and A. THOMPSON. Dated July 8.

10531. "Improvements in the healing electric static cup." E. S. D'ODIARDI and A. THOMPSON. Dated July 8.

10532. "Improvements in electro-inhalers." E. S. D'ODIARDI and A. THOMPSON. Dated July 8.

10577. "Improvements in automatic electric fire alarm systems." P. JENSEN. (Communicated by the European Fire Service and Motor Co., United States.) Dated July 8. (*Complete.*)

10587. "Improvements in electric switch apparatus." P. KNOCH and M. PFEIFFER. Dated July 8.

10593. "Improvements in electric motor apparatus." S. C. C. CURRIE. Dated July 8. (*Complete.*)

19595. "Improvements in apparatus for measuring electrical energy." E. THOMSON. Dated July 8. (*Complete.*)

10640. "Improvements in sash fastenings and sash latch locks, and electric bell contact alarm, burglary preventer and detector." W. W. WILLMOTH. Dated July 9.

10646. "Improvements in apparatus for automatically controlling or maintaining electric circuits." M. H. KILGOUR. Dated July 9.

10712. "Improvements in electric lamp couplers or holders." A. E. NICHOLS. Dated July 10. (*Complete.*)

10714. "Improvements in and connected with electrical apparatus for recording the presence of watchmen, workmen, or others." W. LUCAS and T. A. GARRETT. Dated July 10.

10736. "Improvements in electric lamps for medical and surgical purposes." M. P. OUDIN and H. O. KRATZ-BOUSSAC. Dated July 10.

10740. "Improvements in incandescence bodies for electric glow lamps." SIEMENS BROTHERS & Co. (Communicated by Siemens and Halske, Germany.) Dated July 10.

10741. "Improvements in incandescence bodies for electric glow lamps." SIEMENS BROTHERS & Co. (Communicated by Siemens & Halske, Germany.) Dated July 10.

10742. "Improvements in incandescence bodies for electric glow lamps." SIEMENS BROTHERS & Co. (Communicated by Siemens and Halske, Germany.) Dated July 10.

10743. "Improvements in the means for effecting conducting connection between overhead conductors on electrical railways and tramways and the electrical apparatus on the vehicles." SIEMENS BROTHERS & Co. (Communicated by Siemens & Halske, Germany.) Dated July 10.

10765. "Improvements in means or devices for detecting electrical inductive effects." A. W. HEAVISIDE and R. C. JACKSON. Dated July 11.

10792. "A new or improved combined door knocker and electric bell." F. WILCOCKS. Dated July 11.

10801. "Automatic clock work apparatus for effecting cooking operations, the lighting of fires, and the like, also applicable for giving electric signals." J. J. GILBERT. Dated July 11.

10805. "Improvements in methods and apparatus for applying the power of electric motors, especially applicable to electric railways." B. J. B. MILLS. (Communicated by T. A. Edison, United States.) Dated July 11.

10806. "Improved underground conduit system for electrical distribution." B. J. B. MILLS. (Communicated by E. T. Greenfield, United States.) Dated July 11.

10857. "Improvements in metallic coverings for electric wires." J. M. M. MUNRO. Dated July 11.

10868. "Improvements in electricity meters." E. DE PASS. (Communicated by E. Marès, France.) Dated July 13. (*Complete.*)

10900. "An improved electric switch alarm." C. VANDERBILT. Dated July 12.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1889

6875. "An improved construction and mounting of the spring armature and hammer for electric bells and other like electrical instruments." J. C. WILLIAMSON. Dated April 24. 8d. Consists in mounting the armature on a spring (straight or curved) which may be of steel, brass, or other suitable metal, and which at its free end carries the hammer for an electric bell. 5 claims.

8958. "An electric meter." A. FRAGER. Dated May 29. 11d. Relates to an electric meter consisting of three principal parts or organs:—(1) an electro-dynamometer, which at every instant indicates the electric energy expended per second; (2) a clockwork which indicates the time during which the energy is expended; (3) a counter which registers the product of energy by time on suitable dials. 6 claims.

20261. "Improvements in electric semaphores for railways." F. STITZEL, C. WEINEDEL, A. REUTLINGER, M. J. SCHWARTZ, J. H. EGELHOFF, and J. KEIGER, all of the City of Louisville. Dated December 17. 8d. Has for its object to produce a semaphore which shall be sure and effective in operation. A further object is to so construct the apparatus that but little battery power will be required to operate it. A further object is to so construct a semaphore apparatus that when set the rattling of the parts caused by the jar of a passing train will not operate to release the mechanism. A further object is to construct a semaphore device in which some of the parts make contact with other parts with more or less pressure, so that when it is desired to release said parts one of them will be positively pushed from the other. A further object is to produce a signalling device actuated and controlled by the combined force of weights and electricity, and which shall be compact in construction and sensitive in operation. 14 claims.

20400. "Improvements in apparatus for obtaining a record of the movements of indicators by means of electricity." T. J. MURDAY. Dated December 18. 8d. Has for his object improvements in apparatus for obtaining, by means of electricity, a continuous record from a distance of the indications or movements of instruments or indicators, such as steam pressure gauges, anemometers, aneroid barometers and the like, which are provided with an index or pointer moving over a scale. 1 claim.

20911. "Improved battery plates for storage batteries." A. E. WOOLF. Dated December 31. 8d. Relates to particular methods of constructing the plates. 9 claims.

20971. "An electric exercising machine." O. IMRAY. (Communicated from abroad by the Electric Exercising Machine Company of America. Dated December 31. 8d. Relates to an exercising machine by which when used electric currents are conveyed through the body of the user, thereby obtaining simultaneously the therapeutic effects of the bodily exercise and the application of electricity. 10 claims.

CORRESPONDENCE.

Fire Office Rules.

In reply to Mr. J. B. Verity's letter in your last issue, asking what is to be done to meet the various requirements of the insurance companies, I should like to suggest that the best way to avoid trouble is to carry out all installations in accordance with the Phœnix Fire Office Rules, which are so well known and understood.

I do not think that any other office would object to work, if carried out in this way, as it is well known that the Phœnix rules are the most complete and also the strictest. Surely they cover all other rules, though the latter do in many cases differ, inasmuch as they are more lenient and often do not ask for such good material as the Phœnix, but I do not think an inspector would object on that score. I always carry out my contracts in this way, quite regardless whether Mr. Heaphy will inspect the work, or any other surveyor, and have never experienced any difficulties with the other offices.

It is, of course, a great misfortune that there is not a *standard* set of rules for contractors to work to, as endless trouble might thus be saved. I think the rules of the Institution of Electrical Engineers would have to be considerably revised before they could be accepted as a standard.

F. Geere Howard.

July 20th, 1890.

Electric Traction.

Having read an article in your REVIEW concerning myself, I shall be obliged by your permission to say a few words in reply.

You say that my work will be published in a few weeks' time. You would have been more exact had you said that it had already been published at length in *La Lumière Electrique*, and that almost simultaneously a translation had appeared in the New York *Electrical World*. It has, in fact, been published in Brussels and Madrid as well.

Regarding my method, which I prefer (for Paris, be it understood) to the self-contained car and the electric locomotive, you quote the objections raised by a Parisian journal, that "it would present difficulties in practice owing to the length of the coach." The objection might as well have been taken to the horses, by which the length of the coach is increased some 4 metres, whereas my arrangement would only increase it by 2 metres or 2 m. 50.

You say it is a pity that my scheme is based upon estimates and not upon facts: allow me to disagree with you there.

In devising a practical scheme, which has no present existence (such as electric traction applied to the tramways of the General Omnibus Company of Paris), we are bound to make a forecast of the probable expense, and a detailed estimate of this sort can very well be made upon facts which have a separate existence elsewhere; and the exactness of the entire estimate may be perfect although all the details have as yet not been combined in a single scheme.

Thus if, for example, I estimate the salary of the head of a depôt at 4,800 frs., that of an overseer at 3,600 frs., that of a workman at 1,800 &c., it is because we consequently meet with persons filling these offices on such salaries.

If I estimate the cost of a steam engine at 0·085 fr. per hour, it is because it is well known that under analogous conditions of power and of work in Paris, that is the average cost.

As regards the cost of plates and accumulators, you will admit that I am in a position to judge; and further, I will agree to deliver them to any amount under the conditions I have named.

You say I have taken no account of the conductors' wages, which is perfectly true, and would be equally true of the innumerable expenses which are incident to animal traction as well as electric traction, and which are of no interest in deciding the simple question of trction, and would be a useless complication of the estimate. What is important is the difference between the cost and the net profit of the two kinds of traction, and expenditure which is common and equal to both alike have no bearing on the question. As regards the gross expenditure, therefore, we need only consider the expenditure on plates and accumulators. Now, I read in the *Revue Industrielle* of the 5th July, an assertion by Mr. Frank Wynne, that in England it is not possible to obtain accumulators for electric traction capable of bearing more than 200 charges. Mr. F. King, on the other hand, mentions 450; whereas my calculation was 180 charges. You will, therefore, admit that there is no absolute agreement even in regard to facts; and that, at any rate, by taking the most unfavourable figure, my conclusions in favour of electric traction are more likely to be correct.

Finally, you challenge me to furnish data from a given line in Paris. If you will only take the trouble to look up the journal I have mentioned, you will see the following: "The service is yet too recent to offer any idea of the cost of maintenance of the accumulators." It would, therefore, be of no use for me to ask for these details.

I shall be obliged by your inserting the above remarks in an early number of the ELECTRICAL REVIEW, and beg to thank you in advance, &c.

Paul Gadot.

A Correction.

At the commencement of line 10 in my letter last week about lubricating oils, instead of plaintiff company, it should read *defendant* company.

J. C. Richardson.